GOVT. TOOL ROOM & TRAINING CENTRE

No. 8, KIADB INDUSTRIAL AREA, B.M. ROAD, HASSAN-573201

Government Tool Room & Training Centre

CERTIFICATE

This is to certify that Mr KARTHIK H.S Reg.no:1051816 of 18th Batch, Diploma in Tool& Die Making, has successfully completed the project work on manufacturing /designing of " TWO CAVITY INJECTION MOULD FOR"ANCHOR COVER" In partial fulfillment of sessional requirements' for the award of

"DIPLOMA IN TOOL & DIE MAKING"
From

GOVT. TOOL ROOM & TRAINING CENTRE, HASSAN
During the year 2014-2015

MANAGER
PRIMEX PLASTIC PVT LTD

VIVA EXAMINER

PROJECT GUIDE:
GT&TC HASSAN

PRINCIPAL:
GT &TC HASSAN

PLACE:
DATE:

GOVERNMENT TOOL ROOM AND TRAINING CENTRE

#8KIADB INDUSTRIAL AREA B.M ROAD
HASSAN-573 201

DIPLOMA IN TOOL & DIE MAKING

PROJECT REPORT EVALUATION SHEET

NAME : KARTHIK H.S **BATCH: 18TH**
Reg .No :1051816 **PERIOD : 2014 -2015**

Sl No	CONTENTS	MAX. MARKS	MIN. MARKS	MARKS OBTAINED
01	COMPONENT ANALYSIS	20	12	
02	TOOL DESIGN ANALYSIS	40	24	
03	PROCESS PLANNING	25	15	
04	ESTIMATION AND COSTING	25	15	
05	TOOL MANUFACTURING PROCESSS	50	30	
06	TRAILS	15	09	
07	DEFECTS & REMEDIES	15	09	
08	PRESENTATION	10	06	
	TOTAL	200	120	

REMARKS:

EVALUATOR SIGNATURE

DATE :
PLACE : HASSAN

ACKNOWLEDGEMENT

I express my sincere thanks to the following people without the presence of whom it would have not been possible for me to Complete this project.

To Shri. HALSWAMY.T Managing Director of G.T&T.C for giving me an opportunity of in-plant training In the PRIMEX PLASTICS Pvt Ltd.

Mr. MUTTHU KUMAR (GT&TC Bangalore.). Who helped me by providing training facilities

Heart full thanks to GT&TC Hassan Principal Mr. OBHAIAH.O and Project guide

Mr. PRADEEP and all the staff of GT&TC who were a driving force behind us while perusing the project. There constant encouragement and assistance was of immense help and invaluable.

I express my sincere & gratefully thanks to our Founder Directors
Mr. Pradeep Sethi and Mr. Kamal Neel
Tool Room Manager
Mr. SRIPAD DESHPANDE(design & development Managing Director)

I extremely grateful to our tool room In charge of Mr. YOGESH (tool eng)&Tool Maintenance In charge Mr. RAGHU K.V, Group leader Mr. PUTTARAJU. Senior tool maker Mr. SHRIDHAR for having allowed us to work on this project during training.

And also I am extremely thankful to all the EMPLOYEES of our department & other department employes help for have project shine.

Our respected PARENT Shave influenced this project a lot, they have been extremely co-operative with us throughout this project. For this and more, I am extremely thankful to them. Last but not least, my sincere vote of thanks to all my FRIENDS who helped us throughout this

Yours faithfully

KARTHIK. H .S

INTRODUCTION TO THE INSTITUTION

GT & TC AT A GLANCE

_ *Govt. Tool Room & Training Center was founder in the year 1972, with the assistance of Govt.of Denmark. It has became one of the leading tool room in imparting training and reaching international standards in manufacturing processes, Later in the year 1992 GTTC Mysore was found. GT&TC HASSAN was established in the year 1994. Now GT&TC has its training centers throughout Karnataka at Bangalore, Mangalore, Maddur, Gulbarga, Kanakapura, Hospet, Kudalasangama ...etc*

G.T. &.T.C offer turnkey programs and package programs for tooling. Product development and component manufacturing facilities. It has also embarked upon research and development activities in advanced tooling and machining techniques. It also has been constantly working for the development f the component and system for various R&D organizations with a view to faster self-reliance and technological up gradation. A part from this other major activities of the centre promotion of purposeful technical education of the youth in INDIA, by imparting the highest degree of skill through job oriented training in relevant fields. It is also helping trainees to get exposure to the industries through industrial training.

GTTC - Growth of Centres

1972 Bangalore

1992 Mysore

1994 Hassan, Mangalore, Gulbarga

1995 Dandeli

1996 Hospet

1998 Belgaum, Hubli, Harihar

2000 Maddur, Kudalasangama

2005 Kanakapura, Lingsugur, KGF

2007 Gundlupet, Humnabad, Kadur

COMPANY PROFILE

PRIMEX
AN ISO/TS 16949 :2002 COMPANY

PRIMEX Group

- **Primex Group promoted by technocrats with a mission to offer high quality precision pressed and moulded engineering components to meet the most comprehensive range of applications.**
- **Primex Group has always met the high customer standards and is continuously striving to exceed customer expectations.**
- **Employing Best practices in every activity has been a priority**

PRIMEX
AN ISO/TS 16949 :2002 COMPANY

Leaders for the Future

Mr. Pradeep Sethi and **Mr. Kamal Neel**

Founder Directors

Engineers with extensive Technical and Managerial experience of two decades in the field of Plastics and Sheet metal Manufacturing.

Group Companies

- Started in 1991 with a Mission to offer high Quality precision moulded engineering components to meet the most comprehensive range of applications
- Our products serves the most diverse range of industrial applications. Our customers include OEM's in the field of Automotive, Electrical, power tools, Machine building and other industries
- Started in 1999 with a Mission to offer high Quality precision sheet metal components.
- Currently meets the demand of diverse applications like Automotive Safety Seat Belts, Door Systems, Seating Systems and Exhaust Systems to World Class Standards.

Our vision

- To build a world class company
- Preferred supplier to global customers
- Strive for excellence in quality and reliability, to meet global challenges
- Rapid adaptation to the latest technologies
- Capacity to handle high volumes
- Cost effectiveness through innovative processes

Our Mission

Our activities are the expression of a clearly defined mission. A philosophy… that has indeed become a way of life.

"TO MEET THE CHALLENGES OF GLOBAL MARKET AND SATISFY OUR PASSION FOR EXCELLENCE THROUGH CUSTOMER DELIGHT, COST COMPETITIVENESS, CONTINUOUS UPGRADATION OF ENGINEERING SKILLS AND PROCESSES."

Strategy for Growth

- Product diversification from components to sub-assemblies and products, for various applications
- To venture into new segments such as Clean Room manufacturing for pharmaceutical / medical applications and plastic packaging industry
- To upgrade the Tool room facilities
- To develop Quality Systems to meet World Class Standards
- Human resource development through continuous training
- Expansion through "JOINT VENTURES" and Globalization

Quality Policy

- To supply products that will meet customer expectation on a continuous basis and are delivered on time, every time to retain the position of preferred supplier
- Improve quality level on a continuous basis by involving the work force and also with the involvement of our esteemed customers

The company is focused on training and for involvement of all employees on Quality system activities like Quality circles, KAIZEN, Self-development programs, Safety etc. to all the employees, Associates & Trainees.

The company is focused towards 100% customer delivery, Zero Breakdown & Continuous Improvement.

The important thing in the company is involvement, teamwork, kaizen, Problem solving by Brainstorming.

5S

1. SEIRI (Clearing)
2. SEITON (Arranging)
3. SEISO (Cleaning)
4. SEIKETSU (Standardization)
5. SHITSUKIE (Discipline)

3S

1. SWITCH OFF OK
2. SWITCHED OFF OK
3. STOP OK

SYNOPSIS

Any products to be manufactured invariably require tools. Tool design and development is a specialized and critical area. Since tool is an aid for mass production. It should be accurate and economical for successful life of a product. Tool making is combination of art and science. Moulds are used to produce three-dimensional components. The economy and life of mould reacts entirely on the designer and his role is very important.

The main objective of the project work is to have the detailed knowledge of the mould making techniques, tool processing in properly planned and projective manner.

The project work incorporates the details of studying the designs, process planning and manufacturing of Injection mould, which is a two plate **'TWO CAVITY'** injection mould for **"ANCHOR COVER"**for assembly of checking the **PILLER LOOP & PLASTIC BUSH in TOYOTA INNOVA CORSEATBELT ASSEMBLY.**

This presents an idea of fundamental necessary for processing the tool and to give a clear picture of manufacturing process, i.e., sequence of machining operations involved during manufacturing, assembly of moulds and in the trials.

This process even helps in explaining the functions of main items with line diagram and to give details of the area of work done during the training period.

This design is valid for manufacturing of a successful injection mould.

CONTENTS

INTRODUCTION

INTRODUCTION

INTRODUCTION OF PLASTICS

An engineering plastic is defined as synthetic organic polymer resin made up of many repeating groups of atoms or molecules linked in long chains (called polymers) that combine elements such as oxygen, hydrogen, nitrogen, carbon, silicon fluorine & sulphur, etc.

Engineer plastic is artificially made from a carbon base, which contains various additives thus making it a resin rather than pure polymer. Depending on the bonding they exhibit different properties, some of these important properties of the plastics are:-

- They have very low density (0.90-140gm/cc)
- Thermal & electrical insulation
- Corrosion resistance and adoptable to various colours
- High volume production
- Transparency
- Lesser co-efficient of friction.

They have some disadvantages also:

- Difficult to repair.
- Objection to odor.
- Unstable at high temperature.
- Dimensionally unstable.
- Subject to deterioration

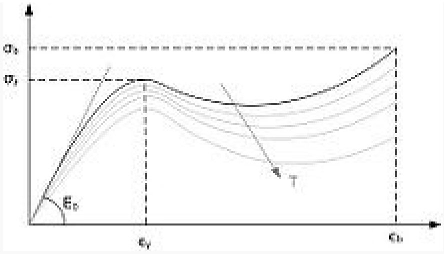
Plastics are categorized in two main groups.

- Thermo plastics
- Thermosetting plastics

THERMOPLASTICS;-

In these plastics the material has long linear molecular structure and will repeatedly soften when heated and will become hard when cooled.. Typical members of this family are Polystyrene, Polyethylene, Amides and Vinyl. Each thermoplastic polymer has certain inherent characteristics, which are due to the chemical composition. Compounding polymers with fillers, extenders and reinforcing with organic and inorganic materials could generate additional desired features.

Most thermoplastics have a high molecular weight. The polymer chains associate through intermolecular forces, which weaken rapidly with increased temperature, yielding a viscous liquid. Thus, thermoplastics may be reshaped by heating and are typically used to produce parts by injection molding. Thermoplastics differ from thermosetting polymers, which form irreversible chemical bonds during the curing process. Thermosets do not melt, but decompose and do not reform upon cooling.



Stress strain graph of thermoplastic material

Above its glass transition temperature, T_g, and below its melting point, T_m, the physical properties of a thermoplastic change drastically without an associated phase change. Within this temperature range, most thermoplastics are rubbery due to alternating rigid crystalline and elastic amorphous regions, approximating random coils.[citation needed]

Some thermoplastics do not fully crystallize below the glass transition temperature T_g, retaining some or all of their amorphous characteristics. Amorphous and semi-amorphous plastics are used when high optical clarity is necessary, as light is scattered strongly by crystallites larger than its wavelength. Amorphous and semi-amorphous plastics are less resistant to chemical attack and environmental stress cracking because they lack a crystalline structure.

Brittleness can be decreased with the addition of plasticizers, which increases the mobility of amorphous chain segments to effectively lower T_g. Modification of the polymer through copolymerization or through the addition of non-reactive side chains to monomers before polymerization can also lower T_g. Before these techniques were employed, plastic automobile parts would often crack when exposed to cold temperatures.
Recently,[when?]thermoplastic elastomers have become available.

Based on molecular structure, thermoplastics can be classified into two groups:

Amorphous and Crystalline.

Amorphous materials never really melt during processing. They just soften and are formed under pressure. These materials posses close dimensional tolerances on the part compared to crystalline materials. ABS, PS, PC, etc. are classified under this group. Crystalline materials have a specific melt temperature and remain solid until this temperature is reached. After the melt temperature is

achieved, the materials flow very easily with very low viscosity. When the material is cooled to a temperature below the melt temperature, the material hardens to a solid form. Nylon, Polyethylene,

Different THERMOPLASTIC molding methods are:

a) Injection molding
b) Blow molding
c) Extrusion molding
d) Thermo Forming
e) Roto molding or Centrifugal molding
f) Calendaring

THERMOSETTING PLASTICS ;-

In thermosetting plastics the resin undergoes a Chemical reaction under the influence of heat, catalyst, ultraviolet light etc. resulting in product that are relatively infusible in characters and are cross-linked materials that are not reversible i.e., the application of heat will not cause the material to soften and upon cooling it will not solidify. Some plastics, which belong to these Categories, are Phenol Epoxies, Melamine, Urea formaldehyde, etc.

Different THERMO SET PLASTIC molding methods:

a) Compression molding
b) Transfer molding
c) Injection molding

Material	Year	Discovered by
NATURAL RUBBER	1839	GOODYEAR
VULCANITE	1843	HANCOCK
GUTTA-PERCHA	1843	MONTGOMERIE
SHELLAC	1856	CRITCHLOW
BOIS DURCI	1856	LEPAGE
PARKESINE	1862	PARKES
XYLONITE	1869	SPILL
CELLULOID	1870	HYATT
CELLULOID PHOTOGRAPHIC FILM	1889	GOODWIN
VISCOSE	1892	CROSS, BEVAN & BEADLE
CELLULOSE ACETATE	1894	CROSS & BEVAN
CASEIN	1903	KUNTH
BAKELITE	1907	BAEKELAND
DAMARD LACQUER	1910	SWINBURNE
POLYVINYL ACETATE	1913	KLATTE
UREA FORMALDEHYDE	1918	JOHN
POLYACRYLATES	1927	ROHM & HAAS
BEETLE THIOUREA	1928	ROSSITER
POLYSTYRENE	1929	IG FARBEN
NEOPRENE	1930	CAROTHERS
POLYESTERS & POLYAMIDES	1930	CAROTHERS
POLYMETHYL METHACRYLATE	1932	CRAWFORD - I C I
MELAMINE	1933	HENKEL
POLYVINYLCHLORIDE	1933	SEMON - B. F. GOODRICH
POLYESTER RESIN	1933	CARLTON ELLIS
POLYETHYLENE (LOW DENSITY)	1933	GIBSON & FAWCETT- ICI
POLYVINYLIDENE CHLORIDE	1933	WILEY - DOW
NYLON 66	1935	HILL - DU PONT
NYLON 6	1938	SCHLACK
PTFE	1938	PLUNKETT- DU PONT

POLYURETHANE	1939	BAYER - IG FARBEN
EPOXIDE RESIN	1939	CASTAN
POLYACRYLONITRILE	1940	DU PONT
POLY(ETHYLENE TEREPHTHALATE)	1941	WHINFIELD AND DICKSON
SILICONES	1943	KIPPING
POLYETHYLENE (HIGH DENSITY)	1953	ZIEGLER
POLYPROPYLENE	1954	NATTA
POLYCARBONATE	1958	FOX
POLYFORMALDEHYDE	1959	McDonald
ETHYLENE VINYL ACETATE (EVA)	1960	DU PONT
POLYIMIDE	1962	DU PONT
POLYPHENYLENE OXIDE (PPO)	1964	GENERAL ELECTRIC
POLYSULPHONE	1965	UNION CARBIDE

INTRODUCTION OF TOOLING AND MOULDING

TOOLING:-

Tool can be defined as hardware necessary to produce any article in large quantity. It can be a Jig or fixture used for rapid machining of parts, a Press tool used for producing sheet metal components, Gauges used for rapid and repetitive inspection, Mould tool used to produce plastic components or a die casting tool used to produce metal casting rapidly.

MOULD AND MOULDING:-

Mould can be defined, as a hard ware comprising of different elements that gives moulding compound desired external and internal shape during the process of moulding.

Moulding of plastics comprises of forming an article to the desired shape by the process of applying heat and pressure to the moulding compound in a suitable mould & solidifying the material in the mould's

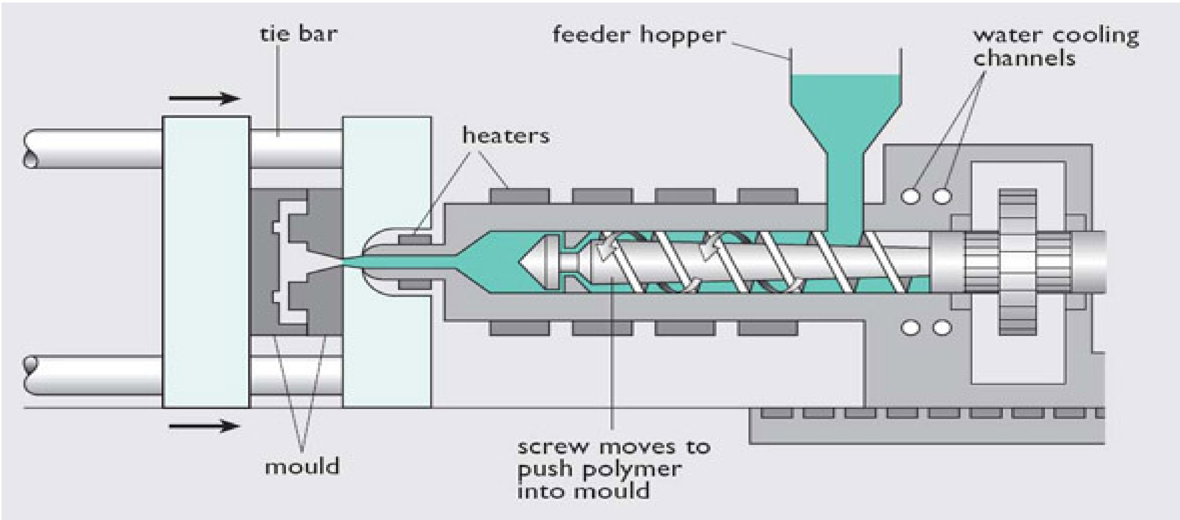
COMMONLY USED MOULDING METHODS:

- Compression molding
- Transfer Molding
- Injection Molding
- Extrusion molding
- Blow Molding
- Rotor Molding
- Calendering
- Thermo forming

Injection Moulding:

Molten plastic is injected under high pressure into a cooled, split mould to produce a high precision moulding

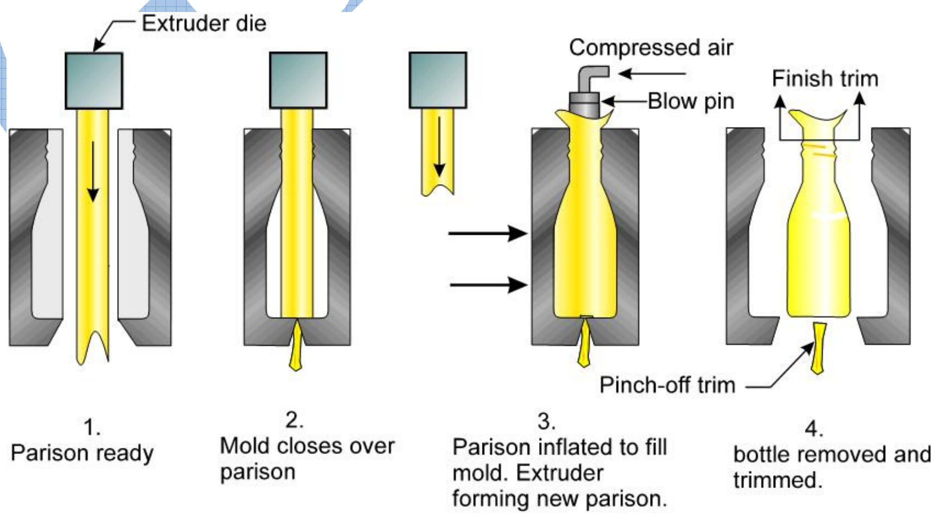
Uses= Buc, Telephones, TV cabinets, Gears, Toys.



Blow Moulding

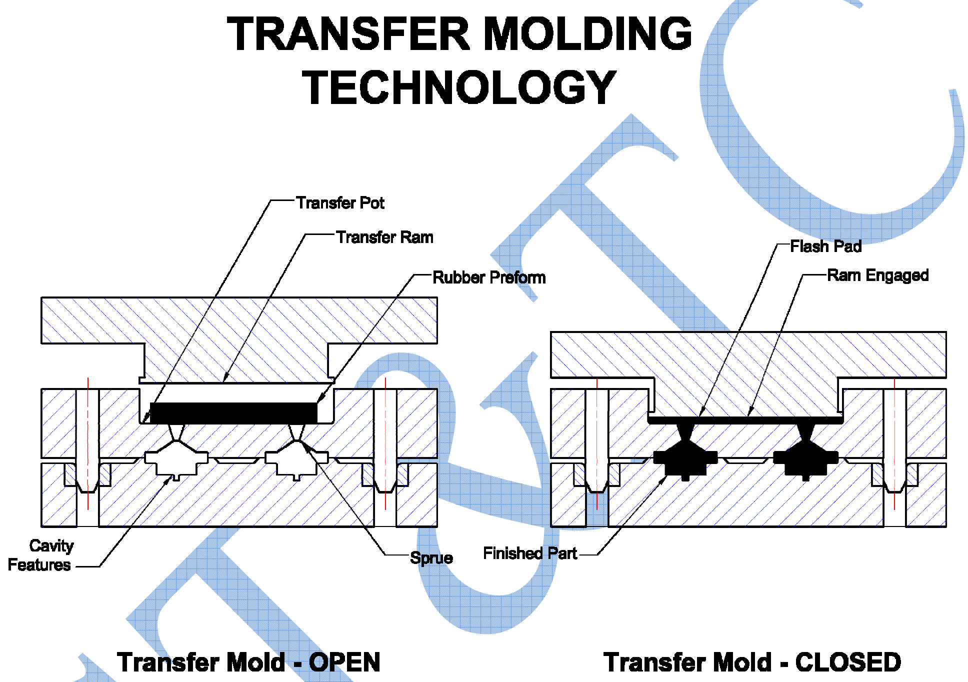
A hot thermoplastic tube is inflated by compressed air into a cooled split-cavity mould to produce a hollow moulding

Uses= Bottles, Drums, Carboys, Car fuel tanks



Transfer moulding:

It is a Closed Mold process in which a pre-weighed amount of a polymer is preheated in a separate chamber (transfer pot) and then forced into a preheated mold filled with a reinforcing fibers, taking a shape of the mold cavity, impregnating the fibers and performing curing due to heat and pressure applied to the material.

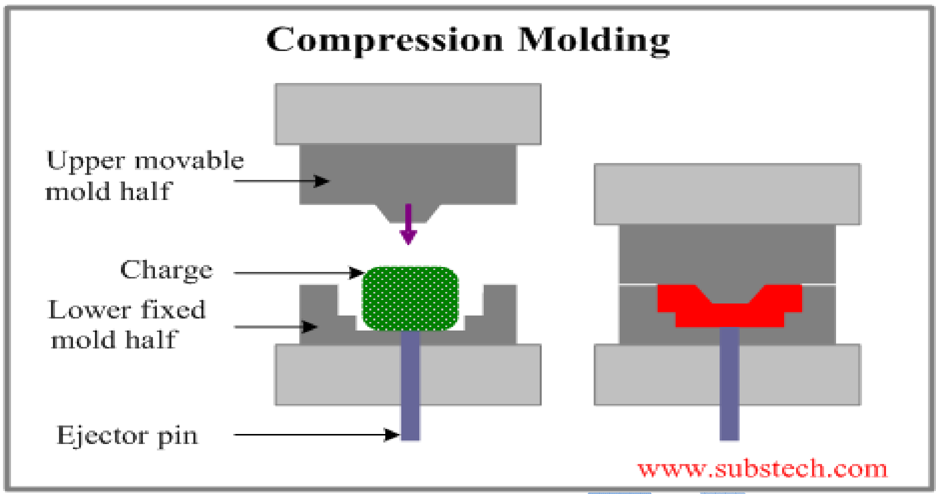


Compression Moulding

Thermosetting plastic powder is compressed and heated in a matched die-set to produce a precision moulding.

Uses =Fuse boxes, Lamp holders, Saucepan handles, Insulators

Compression Moulding



Rotational Moulding

Thermoplastic powder is tumbled, heated and cooled in a split, hollow mould to produce a hollow mouding of simple shape**.**

Uses = Litterbins, Playballs, Traffic bollards

INJECTION MOULDING

Injection moulding is a process in which plastic material is heated and oftener in one part of machine. And then injected under high pressure into the mold where it is cooled and hardened to form the component. In this type repeatedly accurate components can be moulded. It is constant process. Generally thermoplastics are used for injection moulding.

An injection mould consists of two halves, namely top half and bottom half. The top half consists of cavity, which gives the external profile to the component. The bottom half consists of core, which gives the internal profile of the component.

When the mould is closed in an injection moulding machine, two halves are aligned by the main guide pillars and bushes provided in the tool. The melted plastic material is injected under pressure and speed from the heated cylinder by a feeding device. The injected material passes through the sprue, runner and gate to fills the cavity. The material is converted to a rigid state by the water or oil circulated through the cooling holes in the tool. Then the mould is opened and ejector assembly is actuated to eject the component. Thus cycle is continued.

Injection moulding is one of the most important processes for the production of articles from thermoplastic together with plastic and machine use, the mould, which imparts required shape to the article, is an essential factor in this process. The enormous expansion of plastics in all fields is due in part to the intensive development in the area of mould constructions.

INJECTION MOULD AND MOULDING

Injection mould mainly consists of a core, which gives internal shape to the plastic, and a cavity, which gives external shape to the plastic to be moulded. in to which molten plastic is forced under heat and pressure to give it a desired shape. It also in houses all other mechanism, like feeding system, ejector system, cooling channels, etc, necessary to mould and de mould the component.

Injection moulding is the process of forcing or injecting the heated material in to the mould tool, cooling it after it has attained desired shape in the mould and then remoulding it to obtain the component.

Injection moulding cycle basically consists of: –

- Closing the mould.
- Injection.
- Cooling..
- Opening of the mould.
- Ejection.

ADVANTAGES OF INJECTION MOULDING.

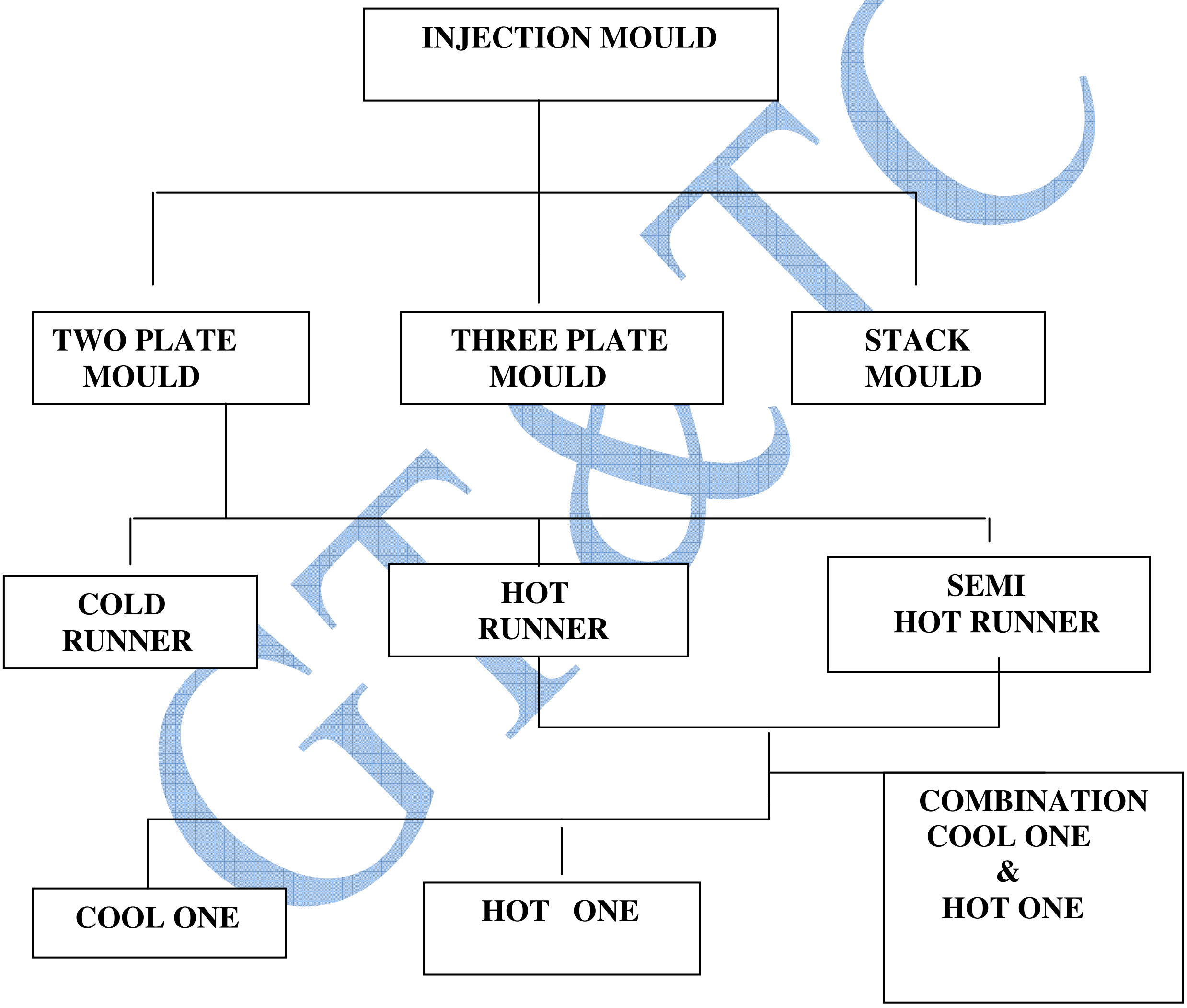
- Parts can be produced at high production rate.
- Large volume of production is possible.
- Relatively labour cost per unit is obtained.
- For many shapes, this is the most economical way to fabricate.

- Where the manufacturing of small parts with any other process is almost impossible parts can be produced in injection moulding.
- Close dimensional tolerances can be maintained.
- Parts can be moulded with metallic and metallic inserts.

Injection moulds are broadly classified as:-

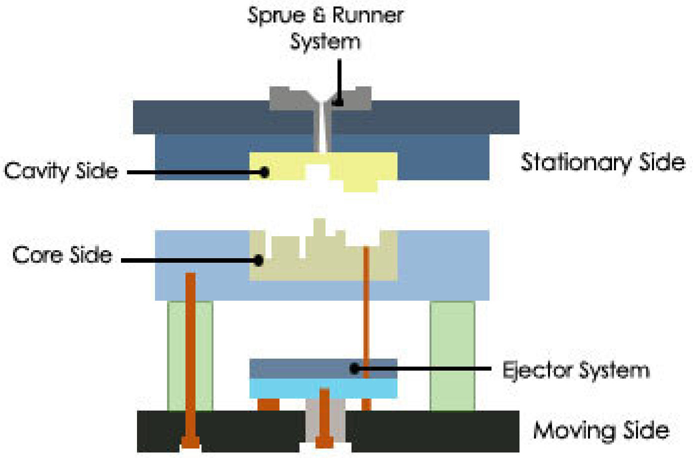
- 2-plate moulds (standard moulds)
- 3-plate mould
- Stack moulds

The following chart shows the further classification of injection moulds: –



2-PLATE MOULD:-

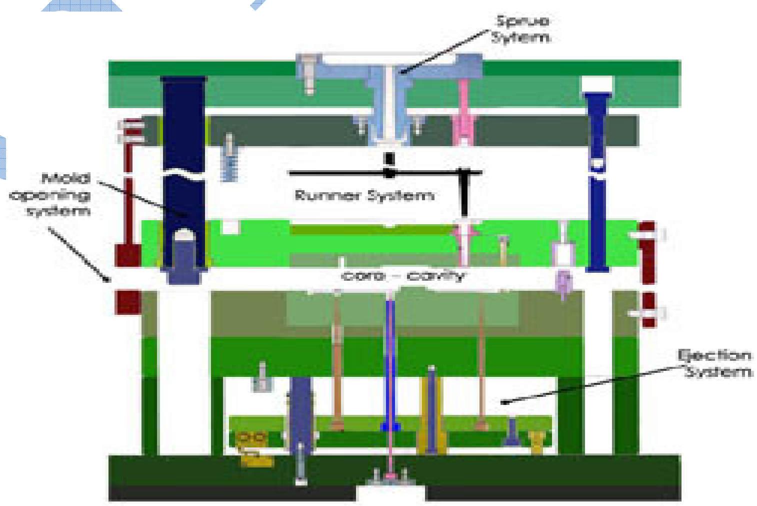
A standard two plate mould is the simplest consisting of one parting line opening or a single day light mould (exception in case of stripper plate ejection). It consists of different parts arranged and clamped in sequence, which make two main units of the mould i.e., fixed half and movable half.



Standard Mold

THREE PLATE MOULD:-

This type of mould having a main necessary parting surface. Feed system will extracted from parting surfaces 1 & component will be extracted from parting surface 2. This type of mould is called "double day light" mould or "three plate mould".

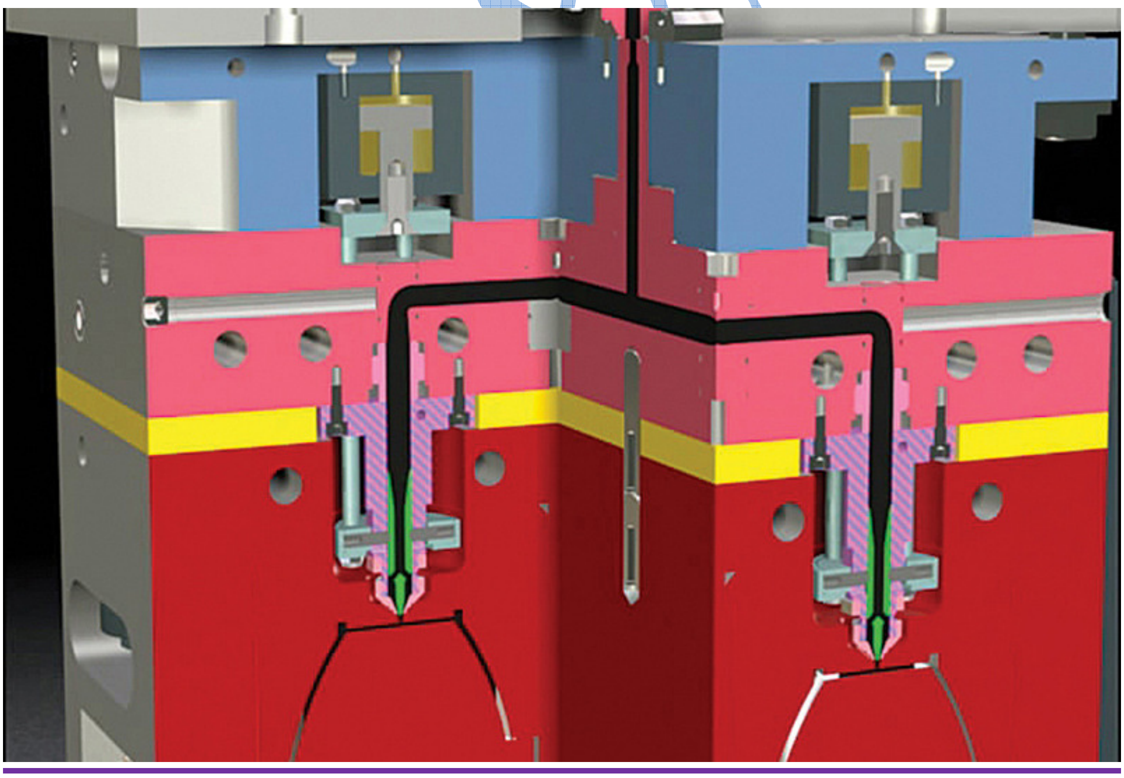


HOT – RUNNER MOULDS:-

This is the name given to a mould, which contains a heated runner's manifold block within its structure. The block, suitably insulated from the rest of the mould, is maintained at a closely controlled elevated temperature to keep the runner permanently as a melt. The polymer material can there by be directed to the mould extremities without loss of heat and without the pressure loss associated with temperature variations.

The main principle of hot runner mould is that the melt is conveyed from the spur bushing to the cavities via. runners while the melt is kept worm all the time so that it remains liquid in the manifold s and is available for the next injection cycle as soon as one is complete .Hence it can be said as extension of injection moulding machine till cavities.

Heating is usually by cartridge heater (which are rigid) or tube heaters (which are flexible).Due to their excellent heat transfer they can be fitted in to hot runner blocks in bores of tight tolerance.



Hot runner systems are mainly categorized as:–

- Cool one system.
- Hot one system.
- Combination of cool one and hot one system.
- Semi-hot runner system.

COOL ONE SYSTEM:–

This is internally heated system, where the material flows through cold manifold around hot tube and internally heated probe.

HOT ONE SYSTEM:–

This is externally heated system, where the material flows inside the hot manifold and externally heated probe.

COMBINATION OF COOL ONE AND HOT ONE SYSTEM:–

In this a combination of both the system is used i.e., if the manifold is designed as cool one system the probe will be designed as hot one system or vise versa.

SEMI HOT RUNNER MOULD:–

In semi hot runner moulds a secondary cold runner is provided to feed the cavities. This is used when direct gating with the aid of hot runner system is not possible or permissible due to the component shape, size and appearance, Here a group of cavities is feed with one hot tip.

INJECTION MOULDING MACHINES:-

John and Isaiah Hyatt received patent in 1872 for an injection moulding machine, which they used to mould champhor-plasticised cellulose nitrate (celluloid)

In 1878 John Hyatt introduced the first multi-cavity mould. In 1909 Leo. H. Bakeland introduced phenol formaldehyde resin with the screw-moulding machine.

The experimental and theoretical work of Wallance .H. Carothers Led to a general theory of condensation polymerization that provided the impetus for the production of many polymers including Nylon. At the end of the 1903's modern technology began to develop and great improvement in material permitted injection moulding to become economically viable.

The main function of an injection-moulding machine is to plasticize the polymer in granular or powder form to homogeneous fluid state.

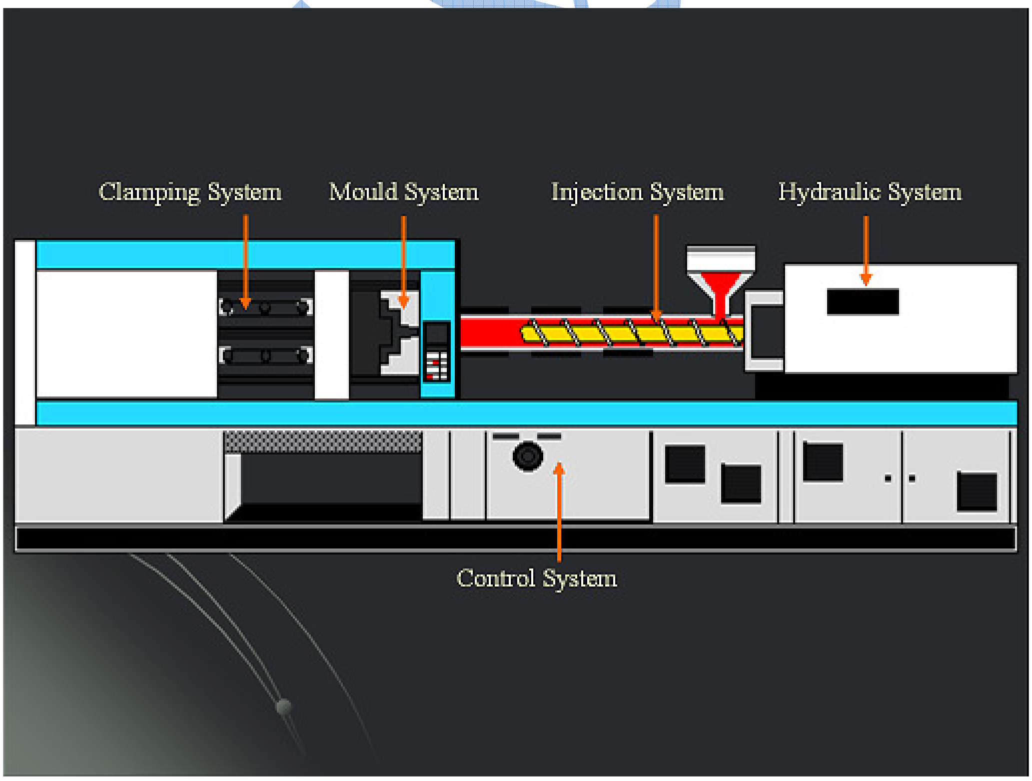


Figure 1

Mainly injection moulding machine can be divided into 3 units.

1. Injection unit.
2. Locking unit.
3. Ejection unit.

Injection unit mainly consists of hopper, heating cylinder, plunger, or screw, nozzle etc,

1). Injection unit:-

Injection unit mainly consists of hopper, heating cylinder, plunger or screw, nozzle etc,.

2). Nozzle:-

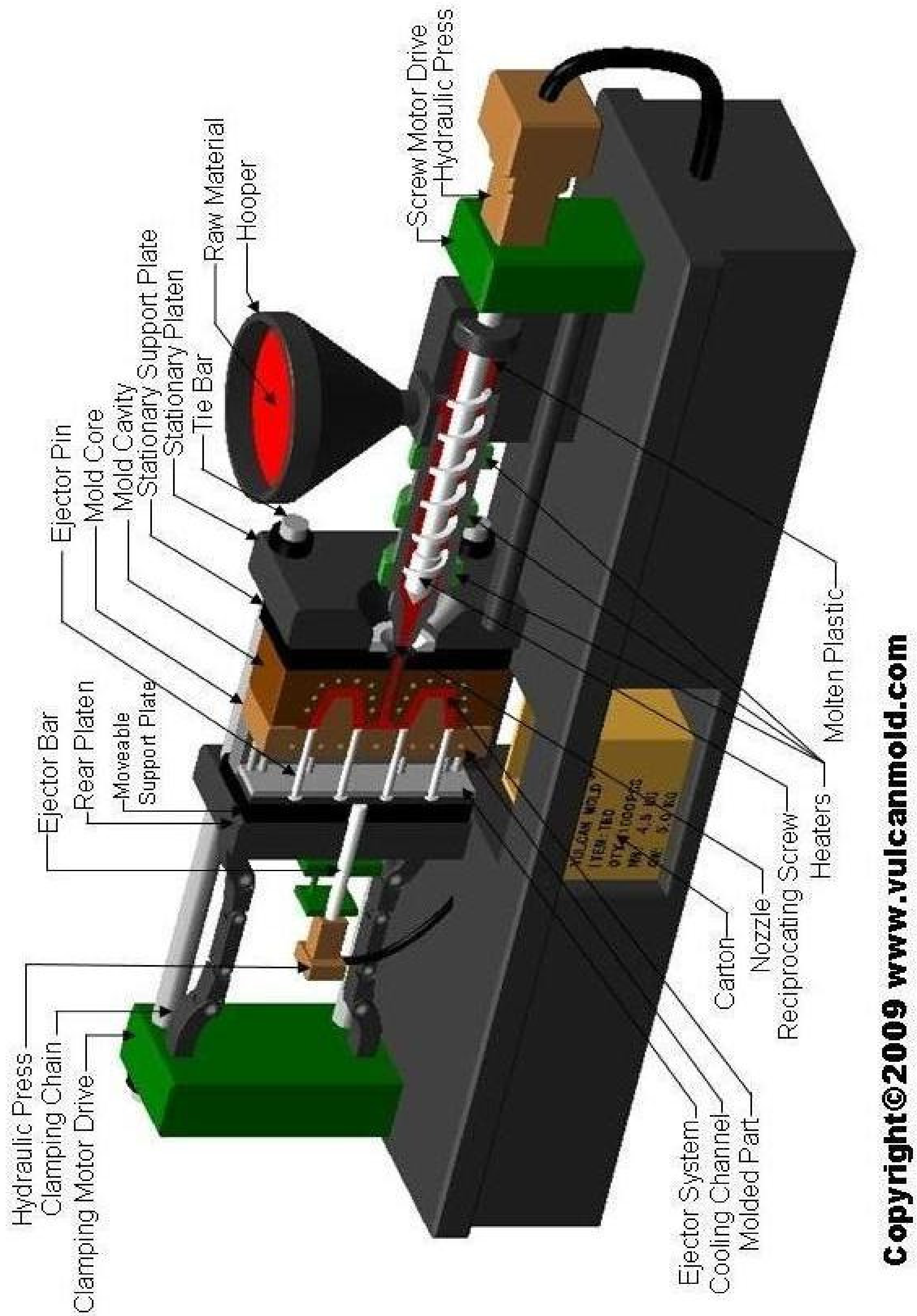
It is point at which the melted plastic leaves the heating cylinder and enters the mould.

3). Hopper:-

Hopper is the reservoir of material from which the material is fed. Heating cylinder transform solid plastic granules to uniform melt.

4). Clamping unit:-

The main function of clamping unit is to hold platen under pressure to over come injection pressure.


Hydraulic Press
Clamping Chain
Clamping Motor Drive
Ejector Bar
Rear Platen
Moveable Support Plate
Ejector Pin
Mold Core
Mold Cavity
Stationary Support Plate
Stationary Platen
Tie Bar
Raw Material
Hooper
Screw Motor Drive
Hydraulic Press
Ejector System
Cooling Channel
Molded Part
Carton
Nozzle
Reciprocating Screw
Heaters
Molten Plastic
Copyright©2009 www.vulcanmold.com

There are mainly three types of die locking;-

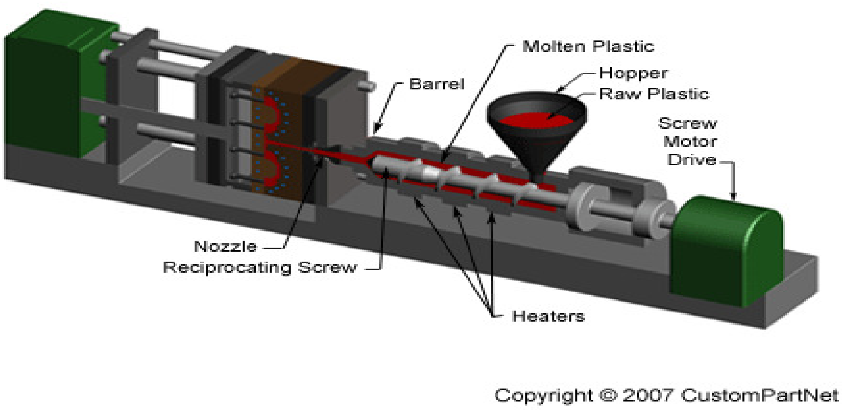
1) Hydraulic plunger type.
2) Mechanical type.
3) Hydro toggle (this is most commonly used).

SCREW TYPE INJECTION MOULDING MACHINE;-

This type of machine consists of a screw rod rotating in a hot barrel capable of elevating or delivering continuous melting of plastic. By operating screw intermittently, one can get an intermittent flow of plastic through the nozzle. Because of the shearing action and material flowing in different patterns there is homogeneity in the melt. From this we can observe that the melted pieces will have better properties than when moulded or processed in a screw type machine.

Especially while moulding engineering items & thick walled items & Items of very large dimensions it is advantageous to use screw type injection moulding machines to have a precise control over all the required properties in an injection moulded products.

In screw type machines the mechanical energy from the screw is converted into heat, which is distributed uniformly throughout plastic as the screw rotates & mixes it. Heating time & thermal degradation is reduced, & mixing of pigment in the plastic is more homogenous.



Ejector unit;-

It consists of knockout plate mounted behind the moving platen. This knockout plate houses the knockout rods.

When the die is opened the knockout rod come into contact with ejector assembly and pushes the ejector unit forward which in turn ejects the component.

There are four basic type of injection moulding equipment in use today.

1) Conventional plunger type.

2) Screw type.

3) Reciprocating screw type.

Out of these reciprocating screw type machine is widely used as it gives uniform melt and lesser pressure drop at the nozzle end.

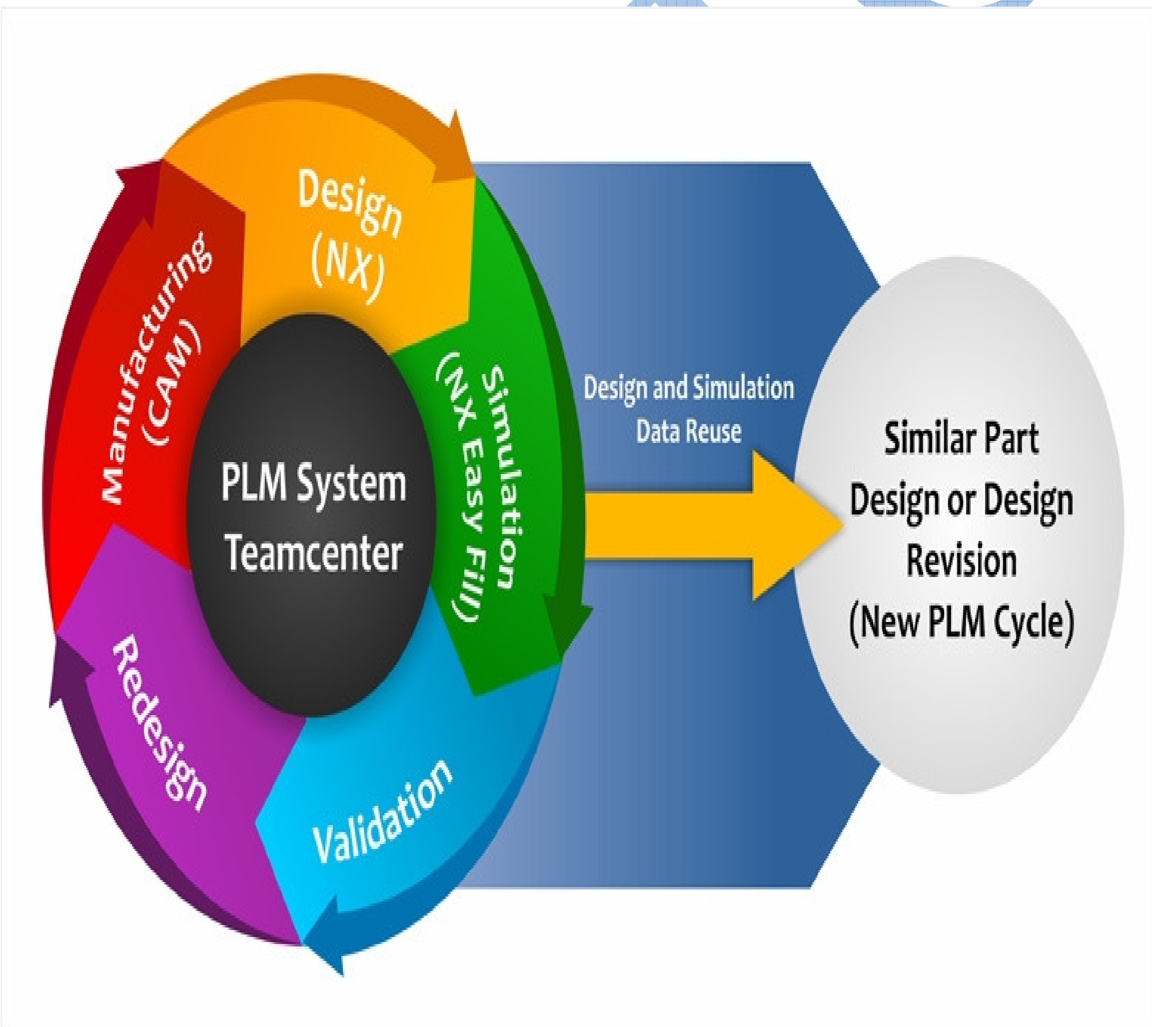
The tack of injection moulding screw is to take the mould pellets at the hopper end compact the material in the feed section degas and plastisize the material in the transition section and pump it in the melting section.

MELTING MECHANISM;-

The solid pellets are connected from the hopper. They touch barrel to from a thin film of melted plastic on the barrel surface. The relative motion of the barrel and screw drag this metal. Which is picked by the leading edge of the advanced flight of the screw. This flushes the polymer down in front of it forming a pool, which circulates. Heat is first conducted from the barrel through the film of a plastic attached to it. Heat then enters the plastic by shearing action, when energy is derived from the turning of the screw. The width of the melted polymer increases as the width of the solid bed decreases; melting is completed at the point where width of the sol

COMPOPNENT ANALYSIS

COMPOPNENT ANALYSIS



CUSTOMER REQUIREMENTS:-

The mould is designed and builds according to the needs specified by the customer. The component drawings are made and then approved by the customer. Following are the customer needs or requirements and parameters of the mold as specified by him:

SL NO	PARAMETERS	
1	COMPONENT NAME	Y3J IMV PILLOR LOOP CAP
2	PART NO	6046956 REV 008
3	TYPE OF MOULD	THREE PLATE MOULD
5	NO. OF CVAVITY	TWO CAVITY
6	MOULD STANDARD SIZE	400x330x310
7	TYPE OF EJECTOR	PIN & ANGULAR LIFTER EJECTOR
8	MOULD WEIGHT	350Kg
9	CORE AND CAVITY MATERIAL	P20 WITH NITRIDING
10	COMPONENT MATERIAL	PP
11	TYPE OF GATE	COLD RUNNER GATE
12	TYPE OF RUNNER	COLD RUNNER
13	TYPE OF COOLING	COLD WATER
14	CYCLE TIME	120 sec (manual)
16	SHOT WEIGHT	37.8gms
18	NO. OF EJECTOR PINS	40
19	MOULD TEMPERATURE	50˚c
20	EJECTOR STROKE	100 mm
21	COOLING TEMPERATURE	15˚c
22	MAXIMUM DAY LIGHT	100 mm

APPLICATION OF

THE COMPONENT : This is used in ***"CAR SEAT BELT"***

COMPONENT ANALYSIS

Before proceeding to the detailed to the tool design analysis component has to be analyzed for its material properties and application of the component.

Component Name : ***ANCHOR COVER.***

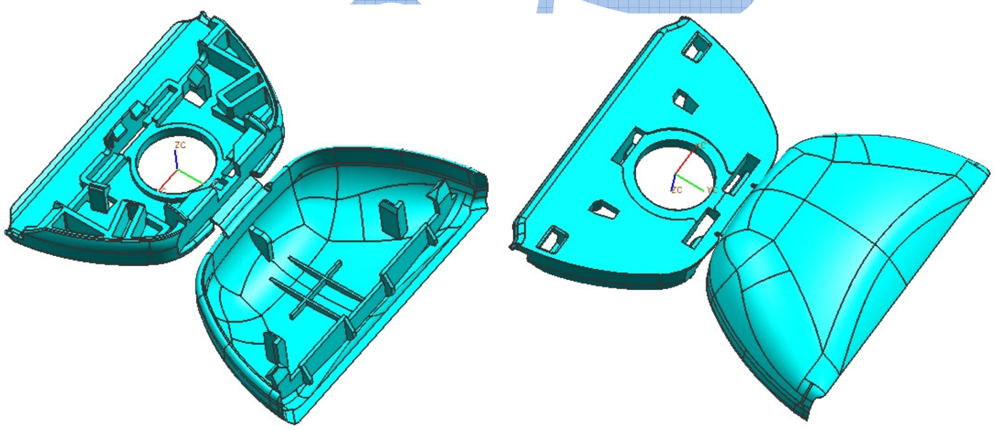
Component Material : **PP**

Shrinkage : ***1.45%.***

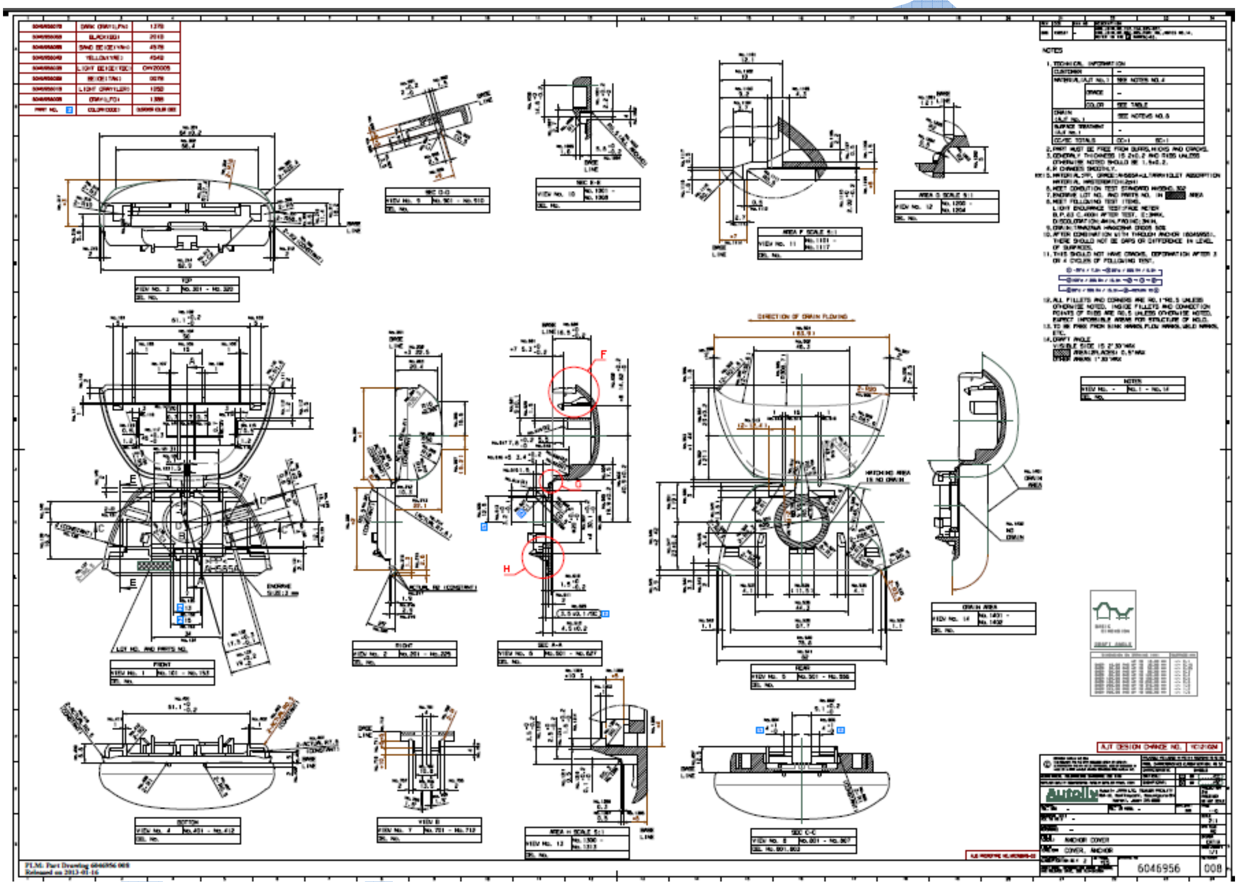
Shot weight : ***37.8Grams.***

Color : ***GRAY.***

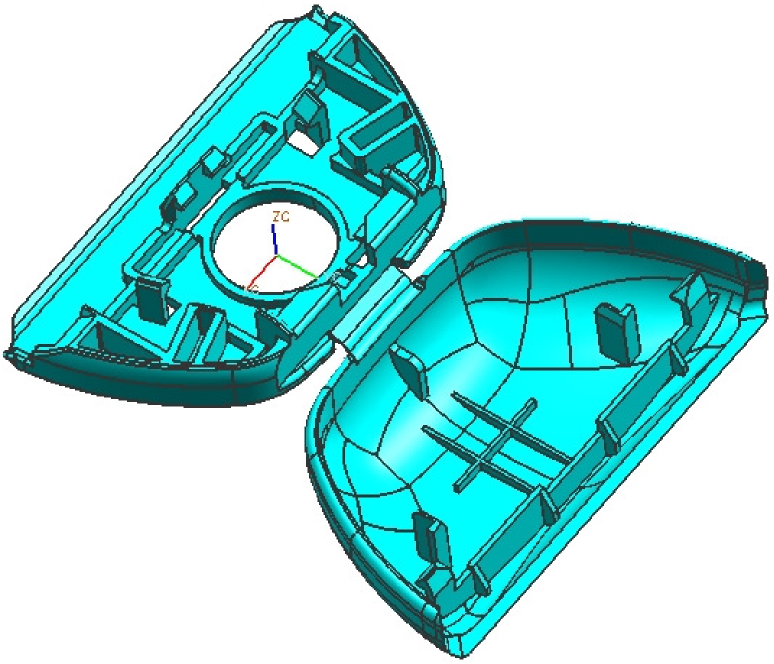
Component Weight : ***24.5Grams.***

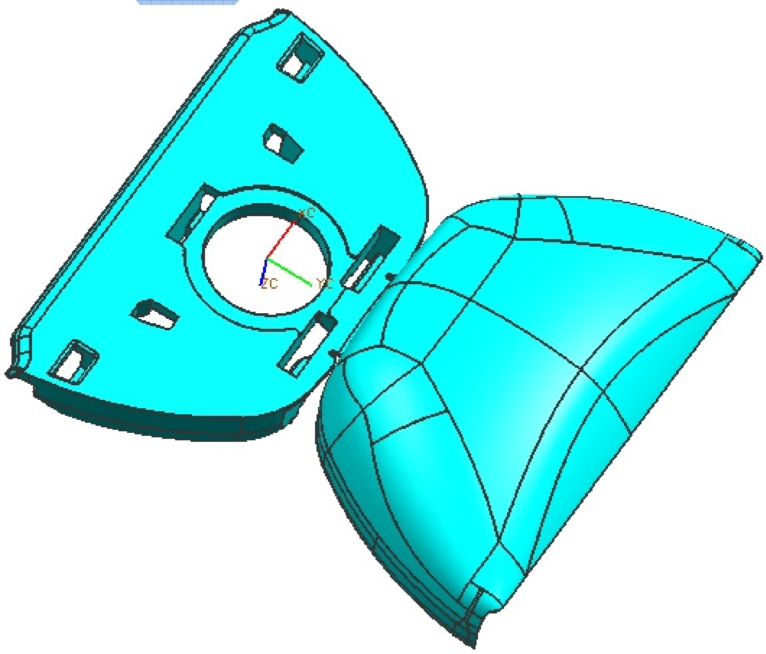


COMPONENT 2D

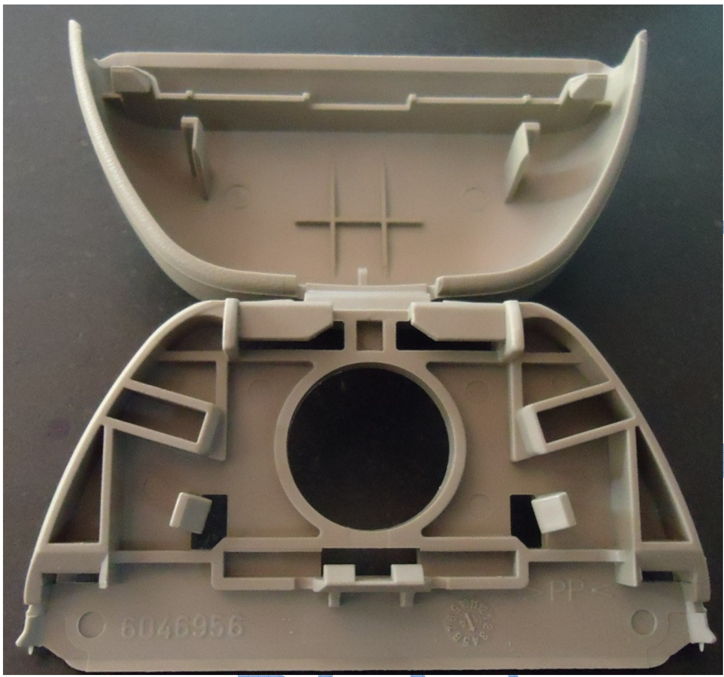


COMPONENT





REAR FACE OF COMPNENT



FRONT FACE OF COMPONENT

COMPONENT ASSEMBLY VIEW

ANCHOR COVER

IMV PILLER LOOP

PLASTIC BUSH

ASSEMBLY DETAILS

ANCHOR COVER PLASTIC WASHER YE3J IMV PILLER LOOP

FEATURE

Due to complicated profile of the housing the core and cavity profile of the component has been design on both the halves of the mould.

IMPORTANT FACTORS OF THE COMPONENT

- The component produced should be as per dimensions specified and should be within tolerance.
- The component should be free from flashes and flash should be within tolerance.
- The component should be free from weld line, sink mark, short shot, flow lines, flash, etc

MATERIAL SELECTED FOR THE COMPONENT

Material selected for the component is an important factor as it gives life and functional aspects of the component. Plastic material selected for this component is PP.

The Inherent Characteristics Of PP Resin:

Mechanical Properties:

- Excellent stiffness and hardness.
- Good toughness.
- Good static and dynamic long-term behavior.

Physical Properties:

- Dimensional stability also at high temperature.
- High heat deflection temperature.
- Good heat ageing resistance.
- Flame retardant grades.
- Good friction and wear properties.

Electrical Properties:

- Excellent electrical insulating properties.
- Special grades with a high arc resistance and high comparative tracking index.

Effect of environmental exposure:

- High chemical resistance.
- Low risk of stress cracking.
- Low influence of humidity on mechanical and electrical properties.

Other Properties:

- Good surface finish.
- Fully compounded colours available.

Processing:

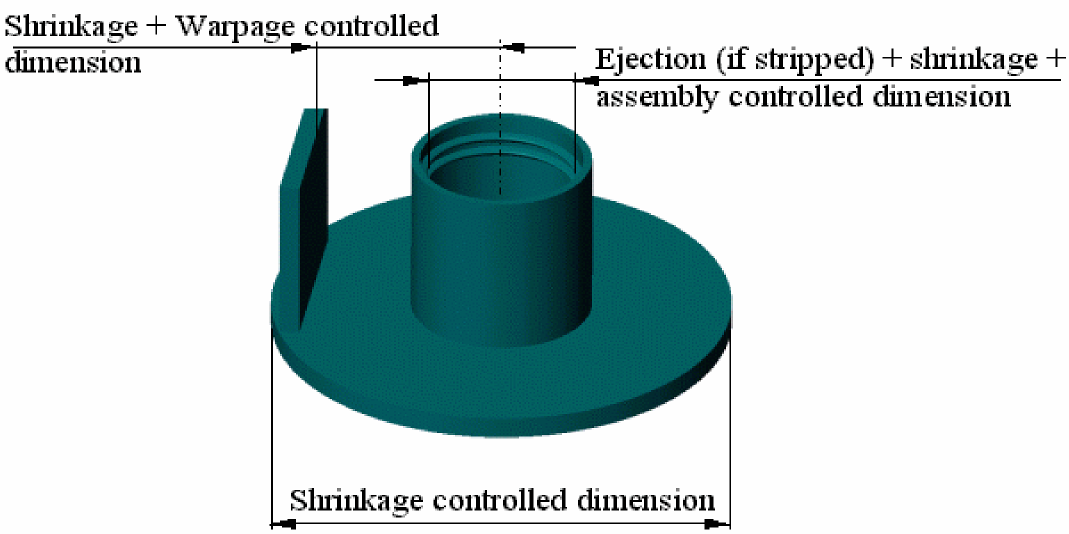
- Standard injection molding machines.
- Good flow properties.
- Short cycle times.
- Pre-drying required (110-130°C, 2 to 4 hours).

SHRINKAGE

As the hot plastic material cools in the mould, it contracts towards the center and will stick to core because of shrinkage factor. Thus while designing a tool, the shrinkage allowance must be added to the core and cavity. Different materials will have different shrinkage and the material manufactures supply them for the given material. The average shrinkage is 0.55%

It is only possible to fix the shrinkage data for mold design for thermoplastic polyurethanes within certain limits because the shape of the article, its wall thickness and the processing conditions all exert a significant influence on shrinkage. As a rough guide for mold design, shrinkage of approx. 1 % can be assumed.

An example of shrinkage calculations



POLY PROPYLENE

(PP-1.0 to 2.5 mm Shrinkage)

APPLICATION ;-

AUTOMOTIVE ;-

Mostly mineral-filled PP is used :dashboard components, ductwork, fan, and some under-hood components.

APPLIANCES ;-

Door liners for dishwashers, ductwork for dryers, wash racks and lids for clothes washers, refrigeration liner, etc

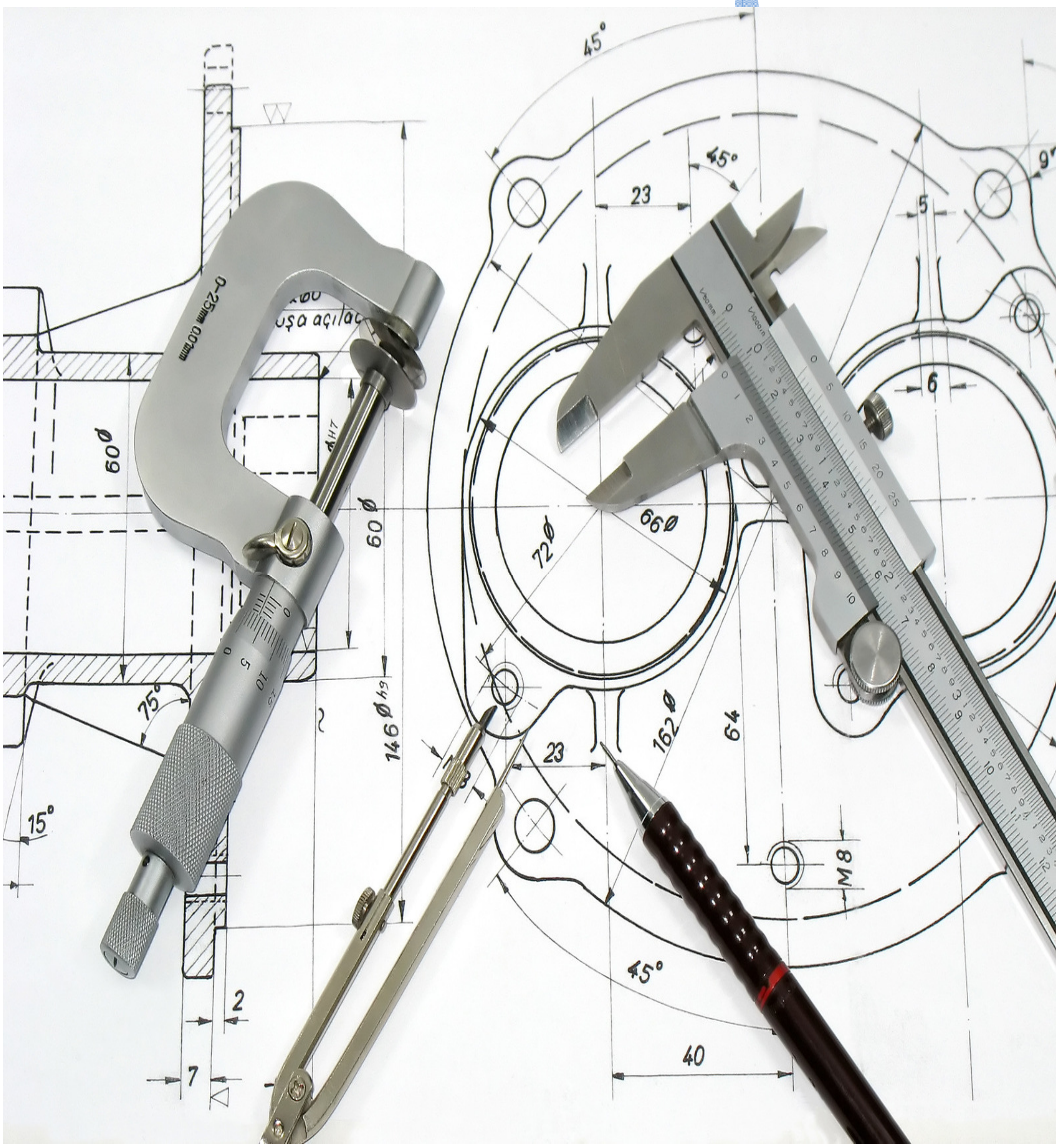
CONSUMER PRODUCTS ;-

Lawn/garden furniture, components of lawn mowers, sprinklers, etc

INJECTION SPEED;-

Typically, fast injection speeds are used to minimize internal stresses, if surface defects occur, slow speed molding at a higher temperature is preferred. Machines capable of providing profiled speed are highly recommended.

TOOL DESIGN ANALYSIS



INTRODUCTION OF DESIGN

Tool designing is specialized phase of tool engineering. Tool design function may be performed by a tool maker in addition to his other duties in manufacturing and also the person who is called to be a designer devotes his working time in tool designing, is to provide drawing.

MOULD DESIGN CHECK LIST.

INJECTION MOULDING MACHINE.

- Is the weight of the moulding, runners and sprue within the shot capacity?
- The clamping pressure of the moulding machine sufficient for projected area of mounding?
- The platen size of the moulding machine?
- Minimum and maximum shut height
- Locating ring diameter
- Lifting arrangement
- Types of location for the cooling

MOULDING.

1. Over flows
2. Ejector positions
3. Gate positions
4. Parting line

- Is the selection of the parting line, the most efficient for the mould construction?
- Have the core and cavity been designed in easiest manner for machining in available equipment?
- Will any slender blades or pins deform under cavity pressure or flow?
- Is the cavity of adequate strength to resist internal cavity pressure?
- Have the material been specified for the core and cavity and other parts of the mould?
- Are all the necessary parts hardened?
- Can all parts of the tool be dismantled and separated in the event of the tool break down or modification?
- Have all the allowance for moulding shrinkage been provided?
- Will the tool dimensions produce the mouldings' within the tolerance?
- Is the ejection stroke sufficient to clear the moulding from the tool?
- Have sufficient ejector pins been provided to prevent sticking, cracking or distortion of the moulding
- Is the ejector mechanism suitable for the particular machines ejector system?
- Have adequate guide pins been provided?
- Are the runners and the gate sizes sufficient?
- Has a specification chart been made for the expandable parts such as springs-rings switches, etc..?
- Have adequate cooling channels been provided?
- Is the plate thickness sufficient to withstand the pressure?
- Does the spherical nose of the nozzle mate with the spherical area of the sprue –bush?

MOULD DESIGN FACTORS

1. Check the component drawing.
2. Check the dimensions of the component in case of Reverse Engineering.
3. Check the material of the component
4. Check the material shrinkage.
5. Check the economy of the tool.
6. Check for the parting line.
7. Check for the total numbers of components and its accuracy.
8. Check for the placement of the component.
9. Check for the type of Moulding machine for loaded And its Specification.
10. Check for the number of impressions for the injection mould
11. Check the type of feed system for the required Volume of the component.
12. Check for the correct location of the inserts.
13. Check the type of gating for that particular shape of the Component.
14. Check for proper ejection system for that particular component.
15. Check for proper positioning of air vents.
16. Check for the proper cooling.
17. Check for the fool proofing of the mould.
18. Check for the shut height of the mould.
19. Check for the radius and chamfer where required.
20. Check for the required finish.

FUNCTION OF THE TOOL DESIGNER AND HIS REQUIREMENTS

- To provide drawing of a tool or set of tools to produce the precise Component
- The tool should be designed economically.
- The tool designer should know the manufacturing process.
- He should have knowledge of standards and procedures.
- He should be able to suggest any rectification to problems arising while assembly, machining
- The tool designer should know how tools perform their function, for this he should have good knowledge of mathematics, mechanics and materials.
- All designs should be clear, complete, exact and easily understood.

DESIGN; –

A design may be termed as complete plan for manufacturing a tool for a given component. It should include all the factors necessary for manufacturing including assembly & detail part drawing with their material, heat treatment procedures, etc. It also gives an idea of the tool on the blue print before it is being actually being manufactured.

Following are the important areas to be looked upon before starting the design ;

- Machine specification.
- No. of cavities.
- Type of feed system.
- Type of ejection.
- Placement of Core &Cavity.
- Parting line of the tool
- Type of cooling.

However, while designing a mould the following points are to be kept in mind with respect to the specified machine.

Weight of the component and the runners should be within the shot capacity of the machine. This weight of the component and runners together is termed as shot weight.

Shot weight of mould= Volume of molding (mm) X weight of plastic material (gm/mm^3) X No. Of impressions + Runner weight.

The shot weight of this mould is = 250 gms.

Clamping force required for mould should be with in the clamping force achievable by the molding machine. It is the force required to hold both the mould halves against opening due to injection pressure during molding process.

Clamping force = Projected area of the component X 1/2 or 1/3 specific injection pressure

Injection pressure = 6.3Mpa

Projected area = Area of component + Area of runner

Clamping force reqd. for this mould is = Tool must be so designed as to it must freely pass through the machine tie bar.

NUMBER OF CAVITIES;-

The number of cavities depends upon the following factors:

- The technical capabilities and facilities available.
- The quality requirements
- The delivery dead lines
- Capacity of molding machine.
- Cost of the tool
- Rate of production required.

Parting surface of the mould are those portions of both mould plates, adjacent to the impression, which close together to form a seal to prevent the loss of material from the impression.

Some important considerations involved are:

Parting line must be provided at a point, which is visually and functionally acceptable.

The choice of parting line should not interfere with efficient of the . molding

It is undesirable that the dimensions calling for high should be divided by flash line.

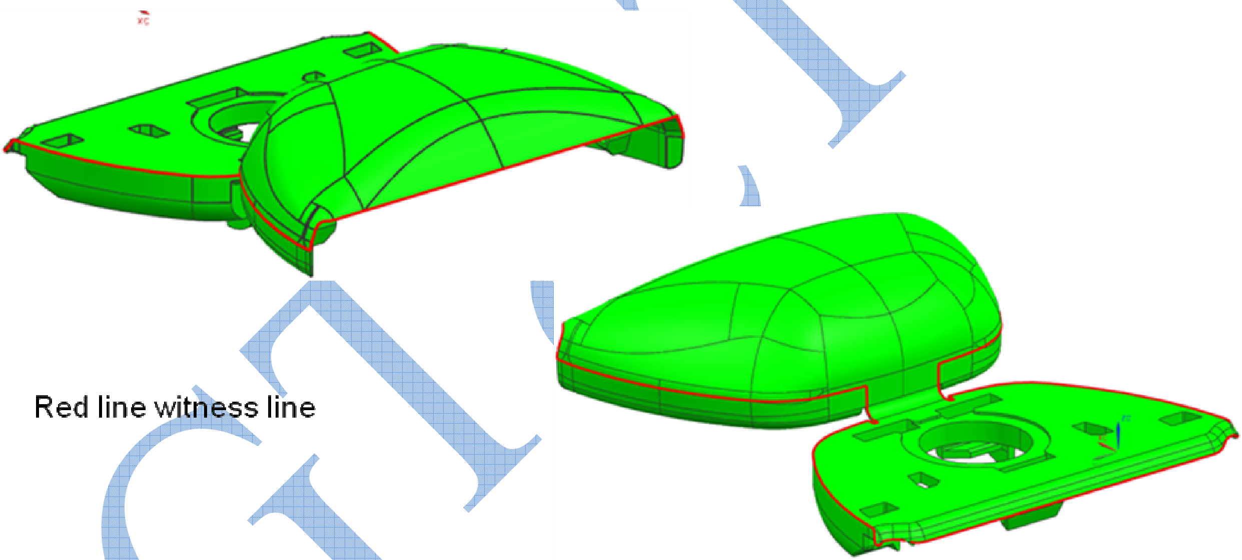
Selection of the parting line:

The first step of the designer is to choose the parting line. Parting line is the line at which the two halves of mould meet and form a seal to prevent the escape of plastic. The lines formed on the component at the parting surface are called parting line. The parting line decides the placement of component in core and cavity. The nature of parting surface depends on the shape of the component.

The parting surface must be so chosen that the canbe easily ejected from the mould. In this mould Profile parting lines adopted for easy injection and ejection of the moulded part.

The types of parting surface are,

- Flat parting surface
- Non-flat parting surface.
- Stepped parting surface
- Profile parting surface
- Angled parting surface
- Complex parting surface.



TYPE OF FEED SYSTEM

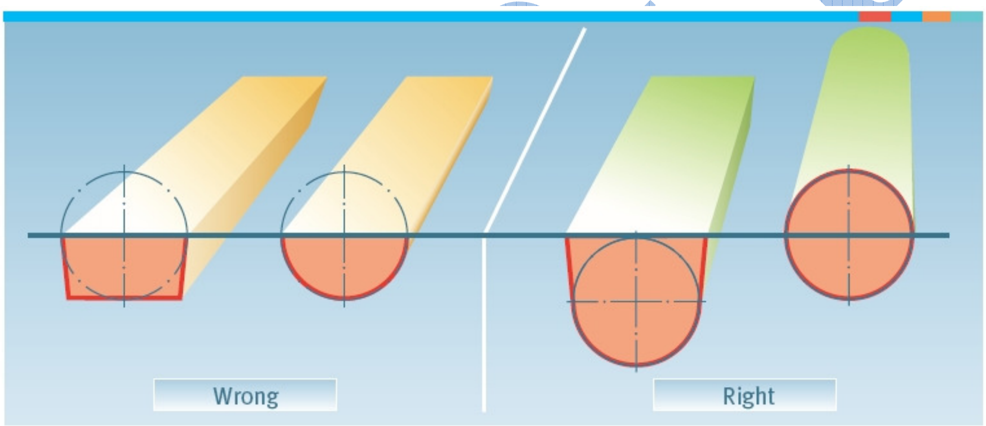
The feed system consists of sprue, runner, and gate. The feed system connects the injection machine nozzle to the impression through the runner and gate.

UNNER DESIGN:

Runner System:

Runner is channel machined in the mould plate to connect the flow path from machine nozzle to the gate. The cross sectional area of the runner must be sufficient to permit the melt to pass through and fill the impression before the gate freezes.

CROSS-SECTION OF RUNNERS



This small cross sectional area is necessary to:

- The gate to freeze soon after the impression is filled
- It allows for single degating
- After degating a small witness mark remains on the component.
- To have better control over filling
- As the cross sectional of the gate is small, the velocity of the material increases during entering the impression.

Selection Runner depends upon following factors:

1. The cross-sectional shape of a runner
2. The size of the runner
3. The runner layout
   - (a) The No. Of impression
   - (b) The shape of the component
   - (c) The type of mould
   - (d) The type of gate

The different types of runner used are:

1. Round
2. Half round
3. Trapezoidal
4. Modified trapezoidal
5. Hexagonal
6. Rectangular
7. "D" Shaped Runner

9. Type of Gate:

It is a channel connecting the runner with the impression. The shape of gate designed for this component is EDGE GATE.

.Gate calculation:

The following formula helps here.

Where, H = height of the gate,

H = n x t

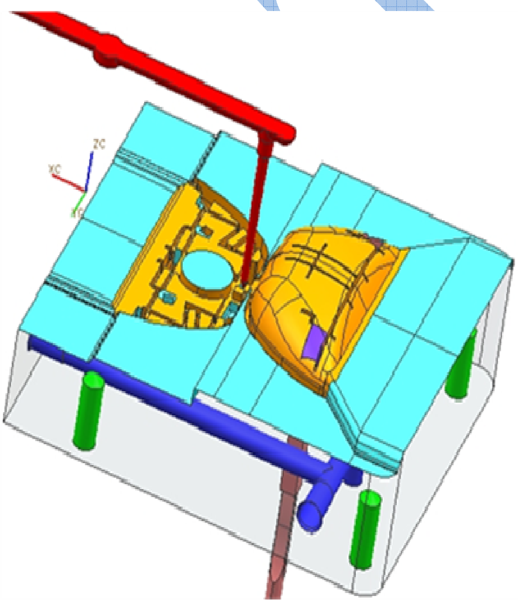
N = material constant,

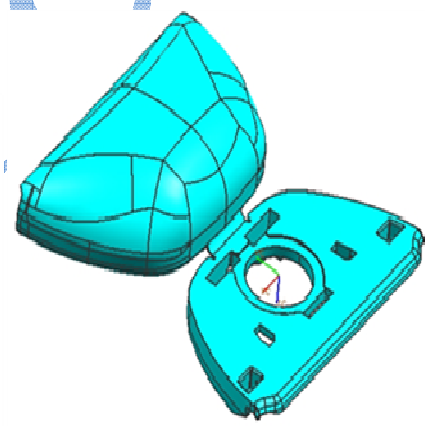
T = thickness

ΦD - Gate Diameter.
GL - Gate Length.
OL – Offset Length, should be minimum 1.0 mm
DP – Depth should be minimum 3.0 mm.

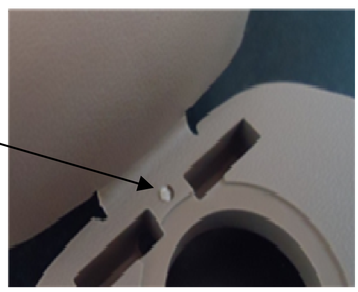
The different types of gates used are:

- Rectangular and Round edge gate
- Sprue gate
- Overlap gate
- Valve gate
- Film gate
- Ring gate
- fan gate
- Submarine gate





Gate position,
Pin point gate



VENTING:-

When the plastic material enters cavity, air inside the mould will be trapped within the mould, resulting in mould defects. Venting is the way, which allows the air to escape freely. Vent is a shallow slot having 0.05mm depth and 3-5mm in width. It can be provided at parting surface or at ejector pins. If venting is insufficient width should be increased but not the depth.

Draft:-

A draft is an intentional taper provided on the core as well as on the cavity inserts as it permits easy ejection of the component. Usually 1/4 - 1/2degree of draft is provided.

The different types of ejection are:

1) Pin ejection
2) Blade ejection
3) Stripper ejection
4) Angular core ejection.
5) Valve ejection
6) Air ejection
7) sleeve ejection

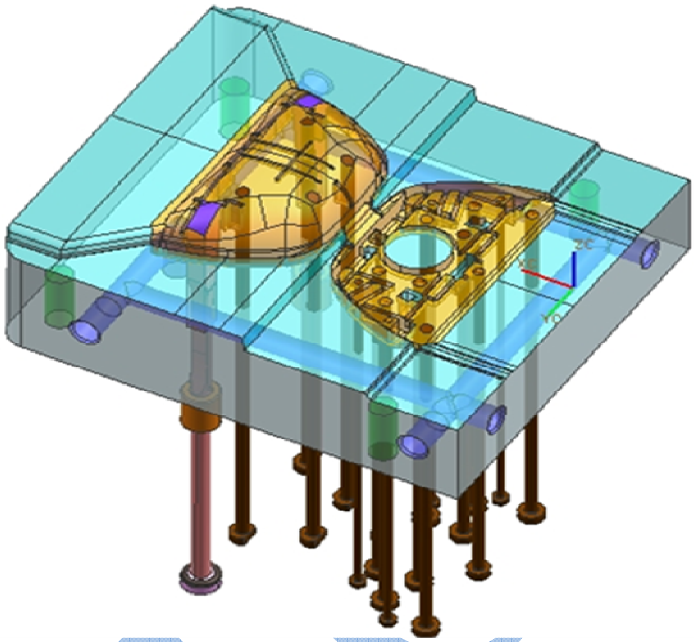
PIN EJECTORS:-

Pin ejectors are made up of O.H.N.S materials.

Following is the manufacturing process:

Round bars of O.H.N.S material is taken for cylindrical grinding keeping stoke & send it for heat treatment. After heat treatment the hardness is checked. Then the cylindrical grinding of the pin according to the finished dimension.

PIN EJECTION



TYPE OF COOLLING:-

The die temperature is one of the most important process to produce a quality component. To maintain the working temperature of the mould, cooling is provided. This can be achieved by circulating oil or water through the cooling channel.

An improperly designed cooling system can result in hidden stresses in small parts, distortion in wall thickness of larger parts and even crack formation can take place. Further insufficient cooling reduces the economy of molding by increase in cycle time. Too much of cooling will cause the component to stick on the core, thus making it difficult for ejection. In designing of hot runner one must be very careful in providing cooling for the mould.

Types of cooling usually used in moulds are:-

1. Plate cooling
2. U-circuit cooling system
3. Z-circuit cooling system
4. V-circuit cooling system
5. Annular cooling system
6. Baffle cooling system
7. Helical cooling system
8. Thermal pipes
9. Bubbler cooling system

COOLING CONSIDERATIONS:

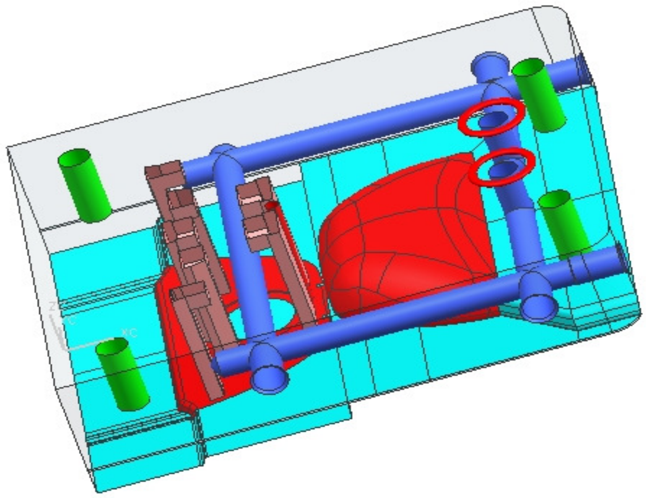
If the wall thickness varies, cooling should be divided into zones.Active area of cooling may be equal to area of component

01) The cooling should ensure rapid and uniform cooling of the molding.

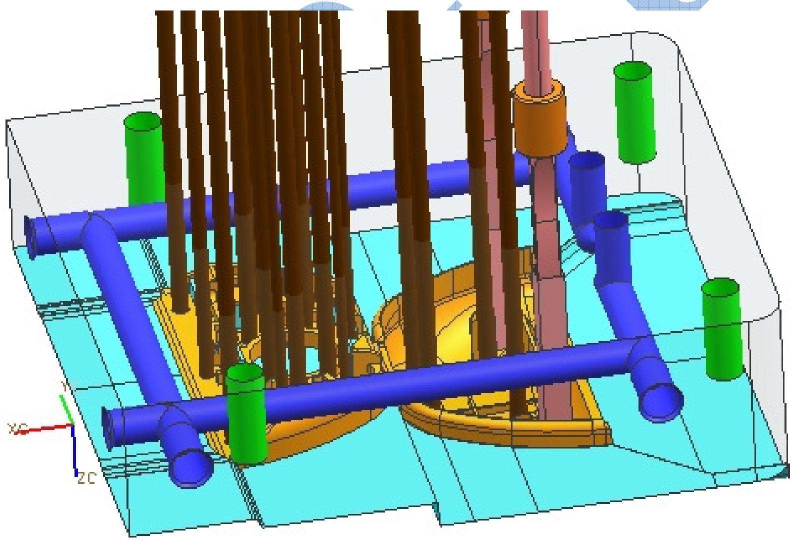
02) The temperature difference between inlet and outlet water is to be 3 to 5° degree.

03) The quantity of coolant through each system shall be between 3 to 5 liters/minute.

CAVITY HALF COOLING

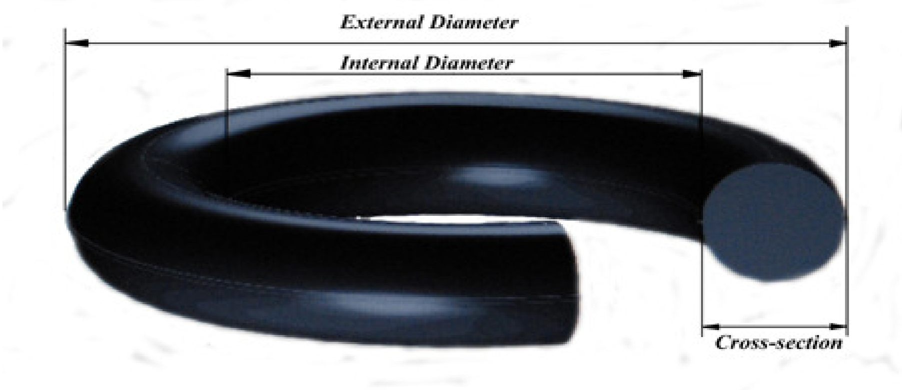


CORE HALF



"O" RINGS

When mould are cooled by methods different from continues channels such as the use of baffle, some sort of gaskting is necessary to prevent leakage rings have a circular cross section and are available in any thickness and diameters. They are made from synthic rubber or silicon rubber where resistance to high temperature is necessary.



PLUGS

Plugs are made from brass or lead. They are pushed into the channels against rod acting as a strip which has been placed into a perpendicular channels Plugs are properly placed to obtain desired flow pattern. All channels is must be free of chips and other obstruction to ensure free passage of the cooling medium.

MOULD DESIGN CHECK LIST

MACHINE

- Is the weight of the molding runners and sprue with in the shot capacity of the machine?
- Is the external output well within the plasticizing capacity of the press?
- Is the clamping pressure of the molding machine sufficient for the project is of the molding and runners?
- Will the mould pass between machine tie bars?
- Do the clamping arrangements for the tool slide the plate bolt holes?
- Is the machine opening stroke sufficient for ejection and extraction of the molding?
- Is the ejection stroke of tool within the capacity of the machine ejector stroke
- Is the ejector mechanism suitable for the particular machine ejector system?
- Do the spherical nose and orifice of the cylinder nozzle mate with the spherical seating and bore of the sprue bush.
- On split tools can all ejectors be in the forward position with out

  Interfering with the clouding of the spill?
- Do any parts of the tool inter fare with the machine parts while working?

TOOL

- The core and cavity should be designed in such a way that the machining can be done on available equipment.
- Are all necessary parts hardened?
- Will the tool dimensions produce molding within component tolerance?
- Will the mould remain on ejections side when mould is opens?
- Have the ejector return mechanisms been provided to prevent sticking cracking or distortion of molding
- Have adequate guide pin been provided between the two halves
- Are all the inserts positively located from position and produced from displacing themselves during tool closing or during plastic flow in the cavity?
- On the split tool or moving cores is the mechanisms sufficiently fool proof to prevent damage by faulty operation?
- Having adequate cooling channels been provided?
- Is the cooling too close or too distance from the mould surface
- Are the runners of sufficient size?
- Has a sprue puller hook and sprue cold well been provided?
- Avoid sharp corners?
- Proper alignment between two halves should be provided
- Side core action guiding length is optimum or not?
- Mould opening and closing sequence are ok or not?.

COMPONENT

- Is the flash line at the tool parting line position is usually acceptable on the molding?
- Will the position of any flow or weld line that may occur be acceptable in appearance?
- Will any heavy section in the molding causes unacceptable sink marks?
- Is the design free of any undercut areas that will prevent ejection?
- Is the function of the part clearly understood?
- Is the gate location correct and acceptable?
- Will the component stick on to injection slide?

RAW MATERIAL SELECTION

RAW MATERIAL SELECTION

The steel used in the manufacture of a mould base varies depending on the requirements of the application proper material selection and proper combination of alloys in varying percentage is required for finished tools. The ultimate basis for the proper selection of tool steel is the final cost or unit part produce by the tool.

The material selection for core and cavity is an important aspect of tool manufacturing, as it governs the accuracy of the molding and the tool life.

RAW MATERIAL SELECTION FOR THIS TOOL

Sl.No.	Description	Material used	Hardnes in C-scale
01	Top,Manifould, spacer block ,Bottam plates, Locating Ring, .	P20	
-02	Cavity & Core Plates	**C45** ' (Carbon steel)	48-50 "
03	Cavity & Core Inserts	**Calmax** (HCHCr)"'	52-54
04	wedges, Straight Locks	**D2** (HCHCr)\	52-54
05	Sprue Bush, Return Pins, rest button, Finger Cam,-Wear	**AISI A2 (Mould Steel)**	56-58
06	MAIN Guide Pillar & Bush,Ejector guide pillar & bush	**HASCO Std.**	
07	Ejector pins	**MiSUMI Std.**	48-50

Criteria for selection of material:

The primary factors influencing the selection of material for plastic moulds are:

- Type of plastic to be moulded.
- Method of molding.
- Design of the part to be moulded. (Size &complexity)
- No of component produced.

Other factors interrelated with the primary factor are physical and chemical properties of mould materials.

- Palatability is essentially important for transparent plastics.
- Where a smooth surface on the final product.
- Where high surface hardness is necessary for resistance to identification polish ability and wear resistance.
- Toughness.
- Minimum dimensional charge on hardening.
- Resistance to corrosion.

The material selected for our tool should have very good dimensional stability under extreme mould temperature (i.e., above 125°C) for a long period. Depending upon on the function it performs, the raw material should be selected for the particular part.

REQUIRED PROPERTIES IN A MATERIAL

With the objective of achieving high functionality of mould, the materials selected for mould parts should possess the following properties.

1. High wear resistance:

In order to increase the life of moulding parts like core, cavity, sleeves etc. High wear resistance on the surface is a must. For better results, the parts are given surface treatment like nitriding or hard coating with Titanium Nitride.

2. High corrosion resistance:

Aggressive components such as flame retardants or even the melt itself can chemically degrade the part forming surfaces.

3. Good dimensional stability:

The processing of high temperature plastics for instance requires cavity wall temperature than can withstand 250° C. Thus the steel should retain its dimensional stability at high temperature.

4. Good thermal Conductivity:

The steel should posse's good thermal conductivity to ensure uniform temperature of mould

After the design is completed the design is verified with checklist then its copies are released to planning, manufacturing and assembly sections. The purchase department is given with a part list first to procure the raw material and standard items for the mould.

EFFECTS OF ALLOYING ELEMENTS:

Effects of Carbon[C]:

Function of carbon is to make the steel hard & wear resistance. Plain carbon steel must be quenched rapidly in water in order to harden up to 0.3% of carbon cannot be hardened as marten-site structure cannot be achieved. Beyond 0.3% steel can be hardened. Adding more carbon i.e., more than 0.8%, it does not increase the measurable hardness, but it increases the wear resistance.

Effects of Chromium [Cr]:

It causes the hardness to penetrate deeper when present in sufficient quantity 1.15% will confer oil hardening properties. Chromium contributes towards wear resistance & toughness to a greater degree than hardness penetration. 4% Chromium in HSS with tungsten & Vanadium increases harden ability.

Effects of Molybdenum [Mo]:

It has both properties of chromium and tungsten. It increases wear resistance & hardness. Hence, it plays an important role in air hardening steels. It promotes harden ability & increases tensile and creep straight at high temperature.

Effects of Vanadium [Va]:

It de-oxidizes and promotes fine-grained structure. It increases red hardness properties. Small percentage of vanadium increases tensile strength, yield strength, hardness and wear resistance.

Effect of Silicon [Si]:

It increases the hardness & wear resistance. It improves cutting / hardness, Resistance to abrasion, good high strength & high red hardness.

Effect of Manganese [Mn]:

Addition of more than 0.5% of manganese to the steel increases the harden ability of the steel.

- It increases the depth of hardness.
- It is resistance to wear, work hardened & abrasion under shock.

Addition of more manganese increases the penetration of hardness. Manganese causes the steel to harden not so rapidly & hence quenched in oil.

Effect if Tungsten [W]:

It increases the hardness & wear resistance. It improves cutting/Hardness, resistance to abrasion, good high strength & high red hardness.

REASON FOR ALLOYING

- To increase harden ability.
- To increase toughness.
- To increase wear resistance.
- To increase machinability.

Following are the materials used in this mould:-

Steels:

- 1.2311 (P-20)
- 1.2344 (H-13)
- O.H.N.S
- 1. 658 (EN – 24)
- 1. 5752 (EN – 36)
- EN – 08 (M.S)

Non Ferrous :

- Copper (Cu)
- Phosphorous Bronze (Ph B)
- Beryllium copper

20:

Material No.: **1.2311**

DIN - specification: 40CrMnMo 7

Composition:	C	Si	Mn	Cr	Mo
	0.4	0.30	1.50	1.90	0.20

Characteristics: Best machine ability and polish ability.
Flame hardenable.

Applications: Used for injection mold core and cavity plates and hard inserts having large cross section .

O.H.N.S:-

Material No.: **1.2510**

DIN - specification: T110W 2Cr 5

Composition:	C	Si	Mn	Cr	V
	1.10	0.50	0.40	13.0	1.40

Characteristics: it is very good wear resistance steel.

Applications: used where high wear resistance is required & sliding areas.
Eg; - wear plate, sleeve ejectors, etc.

EN-24

Material No.: **1.6582**
Composition:

C	Si	Mn	Cr	P	S	Ni	Mo
0.35	0.10	0.70	1.40	0.05	0.05	1.80	0.35

Characteristics: Good machine ability. High wear resistance.

Applications: For parts which requires through hardened upto 50 – 52 HRC, like sprue bush, puller bush, gears etc.

Heat treatment: It is through hardened by simple process of hardening. Hardening temperature is usually 830° to 850° C.

En-36

Material No.: **1.5752**

Composition:

C	Si	Mn	Cr	P	S	Ni	Mo
0.15	0.10	0.6	1.10	0.05	0.05	3.75	0.35

Characteristics: Ability to attain high case hardness with tough core and high wear resistance.

Applications: For parts, which require hard case and a tough core. Usually for sliding parts.

Heat treatment: Case hardening is done to this steel up to a depth of 0.9mm/side. Common case hardening process is adopted for this steel.

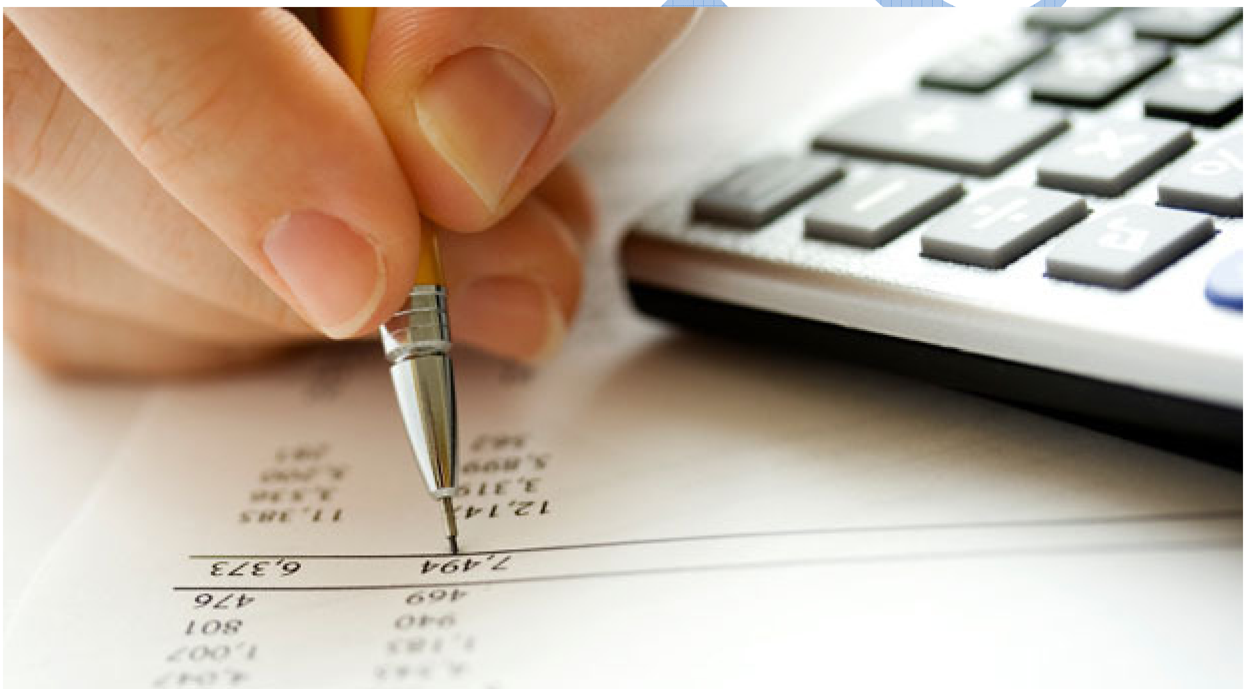
Phosphorus bronze:

Composition;	Ph	Sn
	0.60	11.0

Characteristics; it is a self-lubricating material & wear resistance.

Applications; it is used as cooling insert, guide blocks & also in sliding areas.

ESTIMATION



ESTIMATION

ESTIMATION

Estimation can be defined as an art of finding the cost, which is likely to be incurred on the manufacture of an article, before it is actually manufactured. Thus, it is the calculation of a probable cost of an article before the manufacturing starts. It also includes predetermination of the quantity and quality of material, labour required, etc.

Functions of Estimation:

- Determine material cost.
- Determine labor cost.
- Cost of materials to be procured.
- Determine cost of tools and equipments.
- Overhead charges including selling, packaging and transport.
- Selling price after adding due profit.

Advantages of Estimation:

- To help the owners in deciding the selling price.
- To help in filling up of tenders.
- To decide about the amount of overheads this helps in comparing and checking the actual overheads of the factory.
- To decide about the wage rate of the workers.
- It helps to decide whether a particular item should be procured from market or to manufacture.

AIMS OF ESTIMATION

1. To help the factory owner in deciding the manufacturing.
2. To help in filling up tender enquiries.
3. To decide about the amount of overheads, this helps in comparing and checking the actual overheads of the factory.
4. To decide about the wage rates of the workers after making "Time Study".
5. It helps to decide whether a particular material should be purchased from the market or to be manufactured.

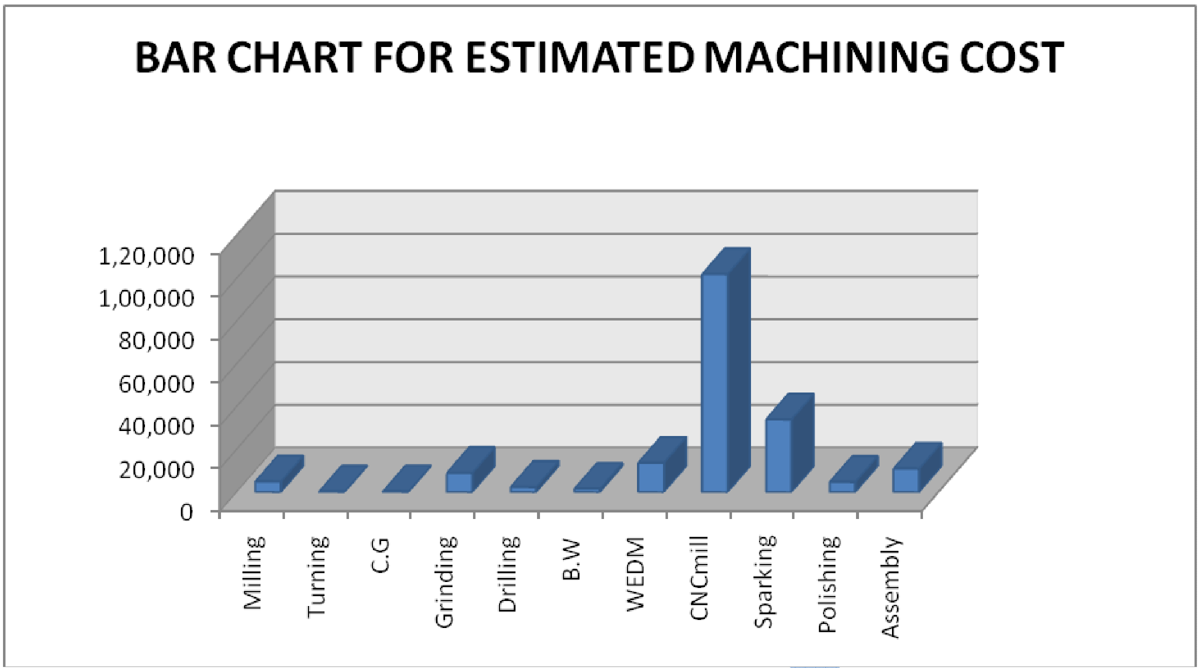
PROCEDURE OF ESTIMATION TOOL COST

Total tool cost:

PRIME COST = Raw material cost + Machining cost + standard item cost +heat treatment + Mould base cost

TOTAL COST = Prime cost + Risk factors + Overheads + Design charges +Inspection + Profit.

ESTIMATION OF MACHININING COST AND TIME



Sl. No	OPERATIONS	RATE /HR IN Rs	M/CTIME IN Hrs	TOTAL COST IN Rs
1	Milling	125	40	5,000
2	Turning	60	5	300
3	Cylindrical grinding	120	3	360
4	Grinding	150	60	9,000
5	Drilling	60	40	2,400
6	Bench work	80	20	1,600
7	Wire EDM	250	55	13,750
8	CNC milling	850	120	10,2000
9	Sparking	200	170	34,000
10	Polishing	120	40	4,800
11	Assembly	200	55	11,000
	Total estimated machining cost			1,84,420

MACHINING COST:-

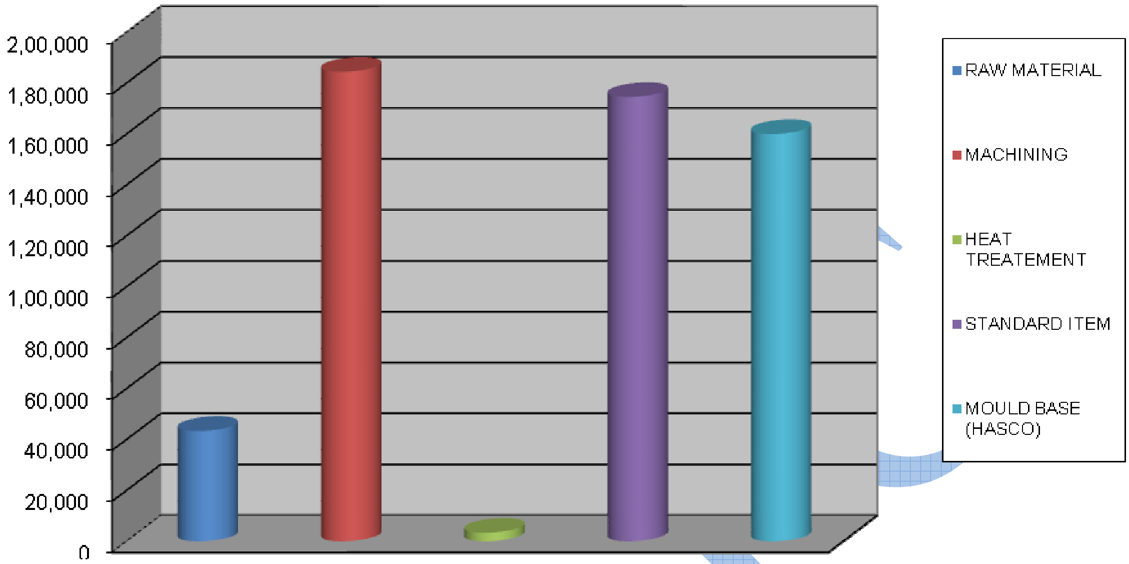
WORK	Rs/Hour
Milling	125
Turning	60
Cylindrical grinding	120
Grinding	150
Drilling	60
Bench work	80
Wire EDM	250
CNC milling	850
Sparking	200

RAW MATERIAL COST:-

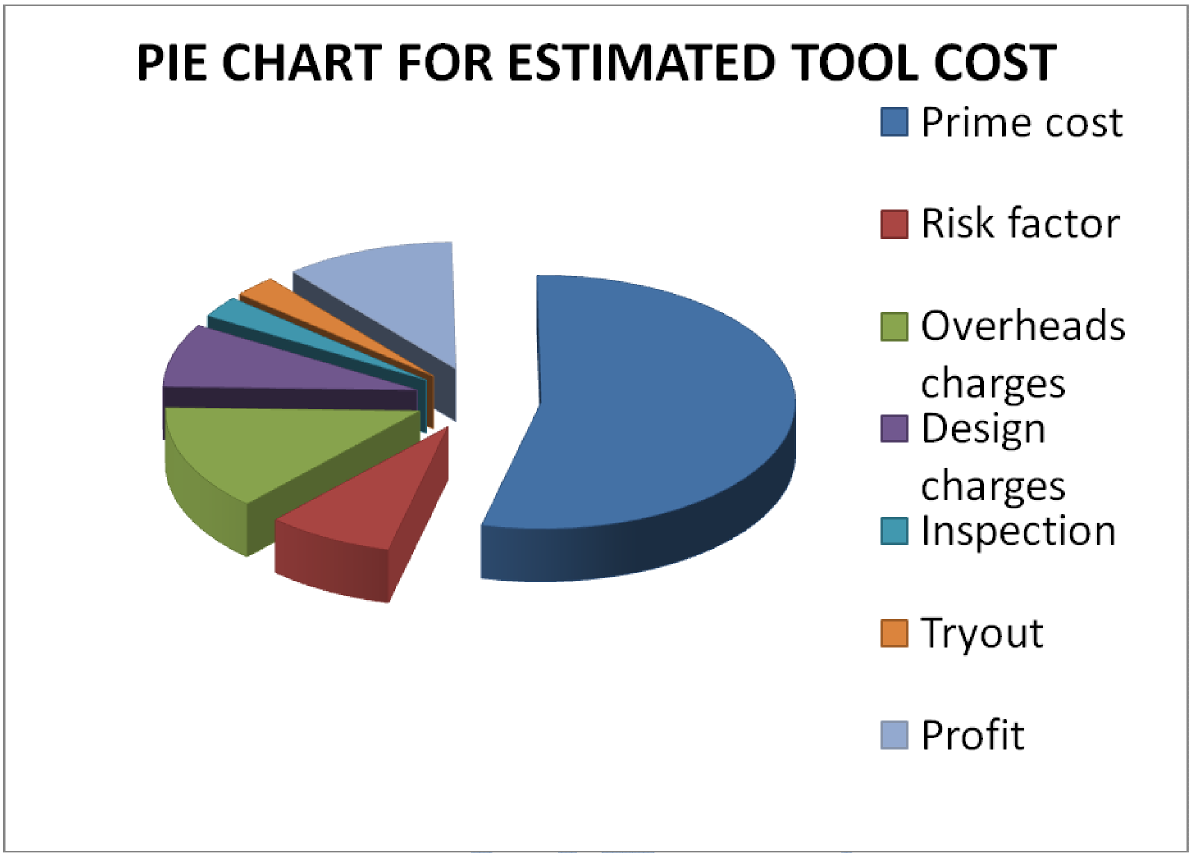
MATERIAL	PRICE/Kg in RS	WEIGHT (K.g)
A2(1.2363)	450	34
1.2767	330	22
ASSAB CALMAX	550	1
VANADIS 10	250	3
ELECTROLYTE COPPER	550	35
P20(1.2312)	210	1

ESTIMATED COST AS FOLLOWS:

BAR CHART FOR ESTIMATED PRIME COST



SL.NO	ELEMENTS	TOTAL COST (Rs.)
1	RAW MATERIAL CHARGES	43,320
2	MACHINING CHARGES	1,84,420
3	HEAT TREATEMENT CHARGES	3,345
4	STANDARD ITEM CHARGES	1,74,485
5	MOULD BASE	1,60,000
	TOTAL PRIME COST	5,65,570



SL.NO	ELEMENTS	TOTAL COST (Rs.)
01	Prime cost	5,65,570.00
02	Risk factor(15% of prime cost)	84,835.50
03	Overheads(25%of prime cost)	1,41,392.50
04	Design charges (15% of prime cost)	24,835.50
05	Inspection (5% of prime cost)	28,278.50
06	Tryout(5%of prime cost)	28,278.50
07	Profit (20% of prime cost)	1,13,114.00
TOTAL ESTIMATED TOOL COST		10,46,304.50

TOOL TERMINOLOGY

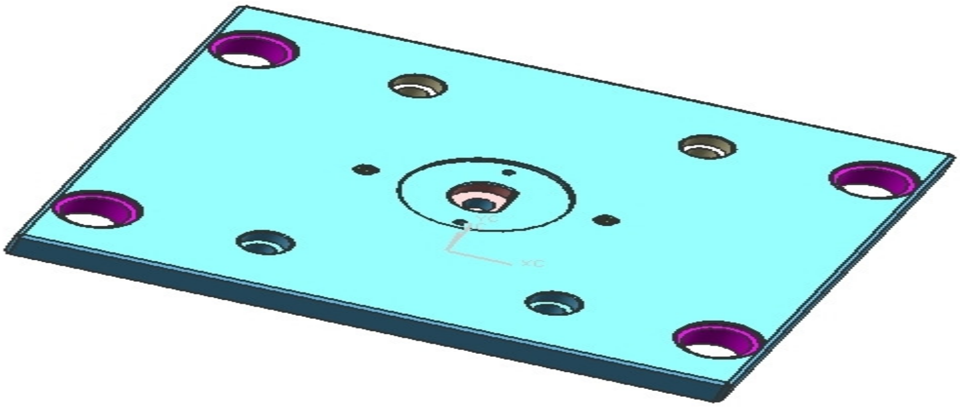
TOOL TERMINOLOGY

1. Top plate:

The Top plate is made of mild steel. This plate should be thick enough to prevent bending; it will be bigger in width tan the cavity plate. This plate is set for clamping the fixed half to the machine platen. It incorporates a hole for sprue bush, locating ring, guide pillar and a screw holes for arresting the cavity plate & wedge housings.

Material: C-45

QY: 1 no.

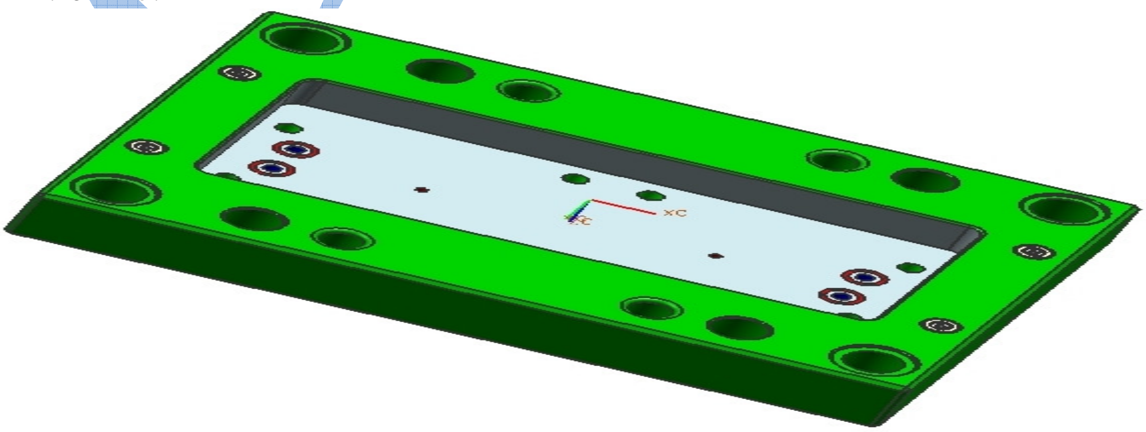


2. Cavity plate:

This plate is used for fixing the cavity in position. In this plate component profile, runner &gates are usually sparked on it. In this plate sprue bush hole is incorporated

Material: P-20(1.2738)

QTY: 01 no.

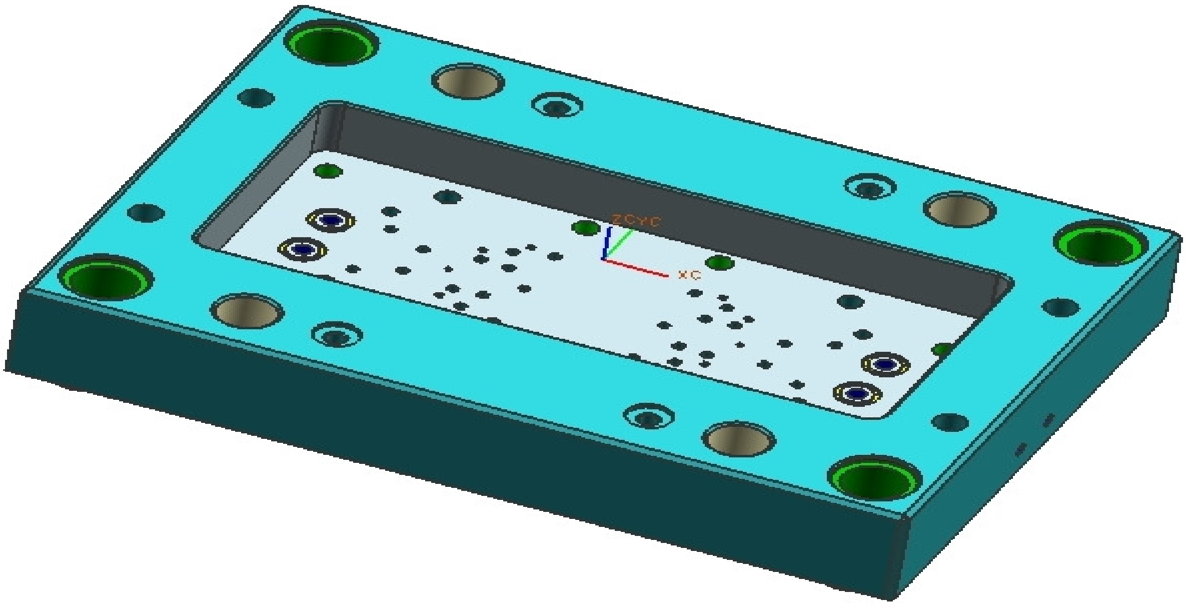


3. Core plate:

This is a plate where core profile is machined so that it is in alignment with the cavity. It also provide provision for incorporating guide bush, core back plate channel for arresting wear plates, guide rails and also a provision for push back pins & ejector pins.

Material: P-20(1.2738)

QTY:01 no



4. Push back pins:

These pins are fitted in the ejector plate and ends in the mould parting line. This is used only to retain the ejector assembly back into its position before the mould closes.

Material: OHNS (T110W2Cr1)

QTY: 04 Nos.   Hardness: 54-56HRC.

5. Locating ring:

This is a disk shaped part seated into a recess in the top plate on the cavity half of the tool. It locates the mould on the fixed platen. Being accurate it ensures alignment of the sprue bush with the centerline of the injection unit nozzle.

Material: C-45   QTY: 01 No.

6. Rest buttons:

These are used between the ejector plate and bottom plate for following advantages.

Where more number of ejectors and core pins are used the height can be adjusted easily.

It leaves the space between the plates, which facilitate the cleaning, if any foreign material falls in-between.

Material: OHNS (T110W2Cr1) QTY: 04 Nos.
Hardness: 54-56 HRC

7. Ejector pins:

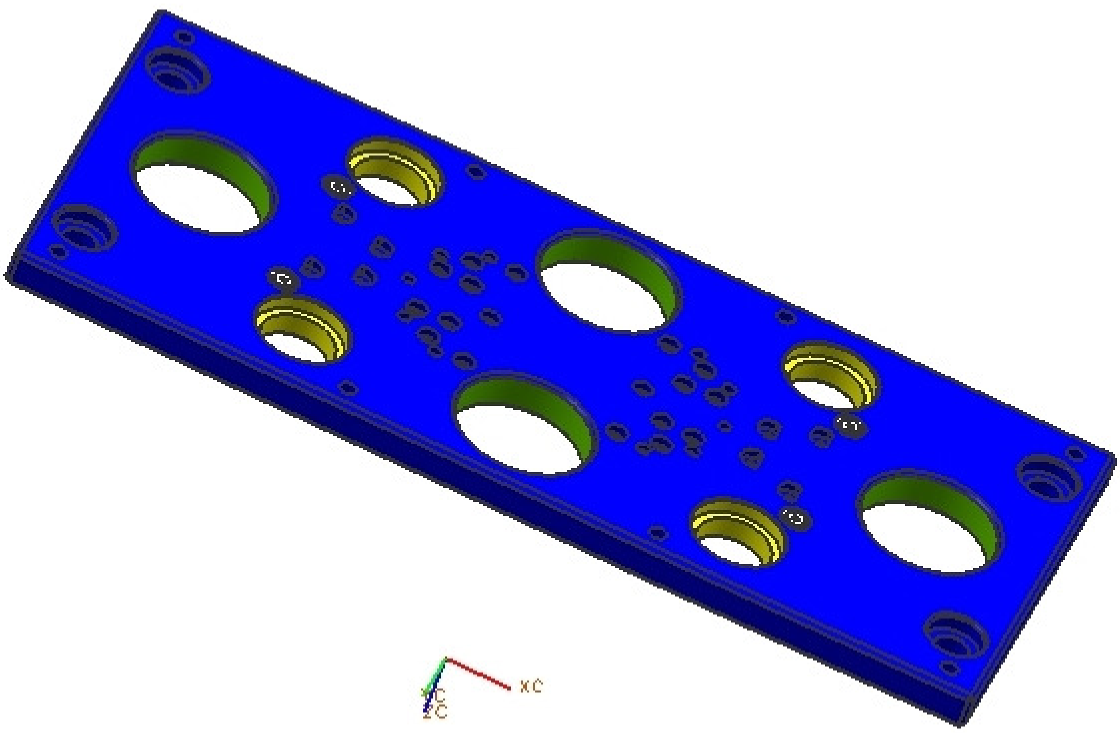
These are cylindrical moving pins used for ejecting the component. It is housed in the ejector plate.

Material: En-24 (40Ni2Cr1Mo28) QTY:54 Nos.
Hardness: 52-54HRC.

8. Ejector plate:

This plate houses all the ejectors pins and push back pins within it.

Material: C-45 QTY: 01 No.



9. Guide pillar and Guide bushes:

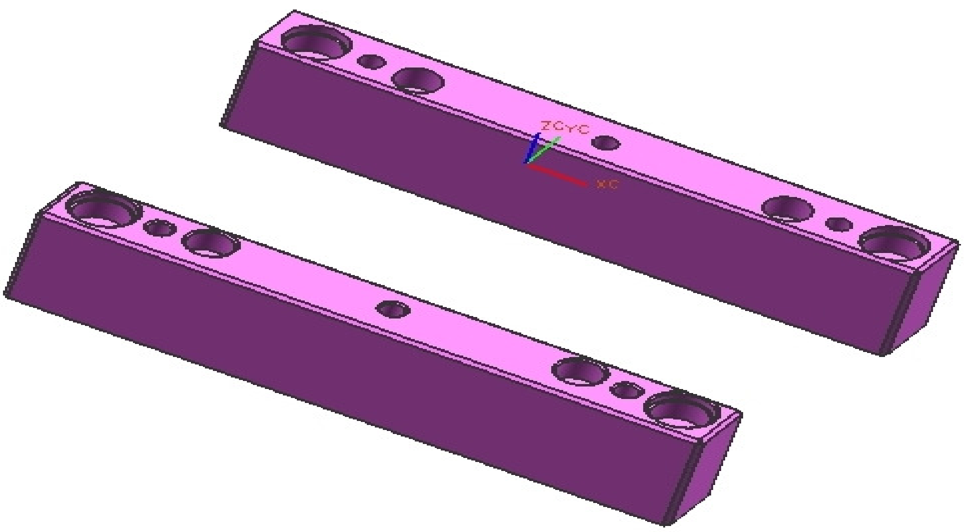
These are used in the tool to get accurate components and align moving half with fixed half when it is loaded on the machine. These are made up of case hardened steel.

Material: 17Mn1Cr95 QTY: 4 Nos .each Hardness 62-64HRC

10. Spacers:

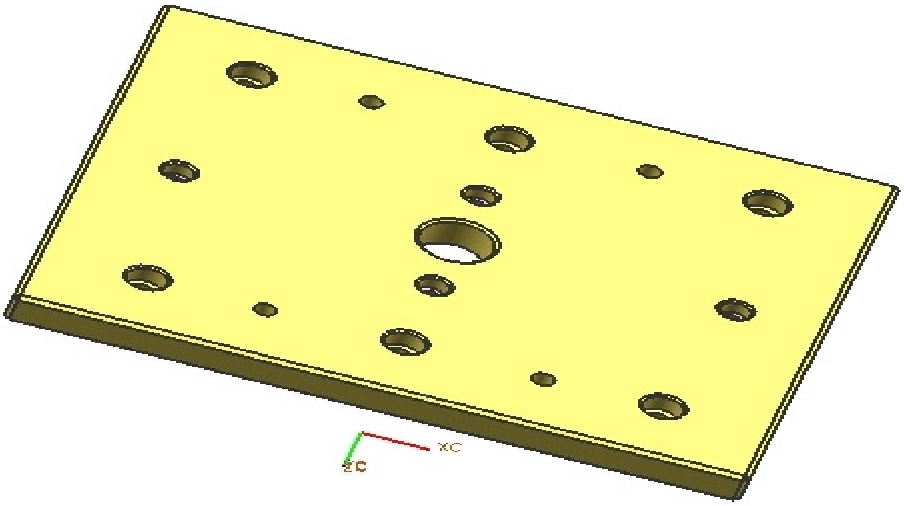
These blocks are used in the mould to facilitate the ejector assembly to be positioned and actuated.

Material: C-45 QTY: 02 Nos.



11. Bottom Plate:

This plate is incorporated next to the spacer. It provides enough room for the moving half to be clamped to the machine platen. It will be of more thickness to prevent buckling. Material: C-45 QTY: 01 No



12. Screws and Dowels:

Screws are used to hold the parts together and dowels are used to align the different parts. Material: STD

13. Ejector back plate:

This plate clamped to the ejector plate, it is used for arresting the ejector pins and return pins.
Material: C-45 QTY 01 No

PROCESS PLANING

PROCESS PLANNING

Before the actual manufacturing of the tool parts, the toolmaker has to decide the process of manufacturing of each part from the raw material stage to the finished product. This procedure is called process planning.Process planning includes developing the method of manufacture the tool, so that it can be provided economically at a competitive price. It establishes the correct sequence of operations.The process planning directly effects the tool cost i.e., an incorrectly planned manufacturing process increases machining time, there by increases the tool cost.For the manufacturing of hardened parts extra care should be taken while deciding the manufacturing process, because machining of the hardened parts is relatively costly and tedious.

REQUIREMENT IN PROCESS PLANNING

- *A brief description of the job to be manufactured.*
- *Specification and standards to be adopted by the job.*
- *Drawing should facilitate all the specification of the job.*
- *Equipment data should include capacity of machines availability of equipment in the job.*
- *Condition and location of existing plant.*
- *Existing man power and staff.*
- *Date of starting and date of dispatch of tool.*
- *Whether special accessories like jigs or fixture are needed.*

Process planning involves following steps –

1. Planning.
2. Routing.
3. Scheduling.
4. Follow up.
5. Inspection.
6. Dispatching.

Steps in process planning:–

- Design review to make quality requirements and manufacturability simpler.
- Study and critically analyze the manufacturing specifications and facilities available.
- Determine what parts are to be manufactured, and what parts are to be purchased directly from the market. Ex:- mould base, ejector pins, dowels, screws, etc.
- Continuous follow up of each part from the raw material to the finished part.
- Prepare a list of raw materials of right quality and quantity.
- Determine the set up time and standard time for each operation.
- Finally determine the estimated cost of the product to see whether or not it will compete in the sales market.
- Determine the most economic process for manufacturing the parts.
- Select the proper machine and best sequence of operation.
- Provide clear documentation of each operation.

- Determine the stages of inspection.
- Assemble all the parts of the mould with proper care.
- Tryout of the fabricated tool.
- Trouble shooting of the component.
- Determine the actual cost of the tool and component.

Electrode planning:

- Analyze the part to be machined and the part to be sparked.
- Freeze the critical dimensions in the electrode.
- Procure the required raw material size as per requirement.
- Determine the machining operations for the electrode.
- Prepare the electrode drawing for actual manufacturing.

PROCESS PLANNING FOR MANUFACTURING OF CORE & CAVITY

Since these parts form the heart of the mould, top priority should be given.

- Make a detailed study of drawing and important dimensions.
- Go for economy as well as quality depending how best a particular profile can be machined on a particular type of machine with less cost.
- See that inserts are periodical stress relieved, so that no towards cracks and stress develop into them.
- After each operation, clear the inserts for fool proof inspection.
- Do not have excess material as their process on special purpose machines is comparatively costly.
- The machining operation of core, cavity can be bifurcated as:

a. Conventional - Drilling, milling, turning, grinding, etc,

b. Non-conventional - EDM, WEDM, CNC TURNING, CNC MILLING,

INFORMATION REQUIRED TO DO PROCESS PLANNING:

1. Quantity of work to be done along with product specifications.

2. Quality of work to be completed.

3. Availability of tools, equipment & personals.

4. Standard time for each operation.

The planning dept. gives a step by step description of the process in which a product has to be manufactured. An efficient planning system will help in making good quality moulds economically within the stipulated time.

MOULD CONSTRUCTION MATERIALS AND THEIR HEAT TREATMENT:

Selection of mould materials should be made very carefully as the strength and life of the mould depends upon the materials used for its construction. To ensure this, material used for mould construction should meet various requirement like:

- Hardenability
- Adequate toughness.
- Polish ability.
- Thermal conductivity.
- Heat, corrosion & wear resistance.
- Resistance to mechanical and thermal stress.
- Dimensional stability under heat treatment

Materials used for mould constructions are mainly metals. They can be broadly classified as ferrous and non-ferrous.

HEAT TREATMENT OF STEELS:

Heat treatment is the process where the physical property of a metal is changed by subjecting it to a combination of heat and cooling.

Heat treatment is done to achieve the following purpose:

- To enhance fabrication.
- To Improve machine ability
- To relieve internal stress.
- To Improve mechanical properties such as ductility, strength, hardness, toughness etc.
- To Make changes in the grain size and structures.
- To get softening & hardening .

Following are the types of heat treat done to steel:

- Annealing
- Normalizing.
- Hardening
- Tempring
- stress relieving.
- Stabilizing

HARDENING;-

It is a process of heat treatment done to steel to increase its hardness and wear resistance. Methods of hardening are: -

1. Through hardening.
2. Case hardening.

THROUGH HARDENING:-

This is done to achieve hardness through out the steel. The temperature, time of hardening and procedure of quenching depend on the hardness required, the type of steel to be hardened and volume of the steel. It commonly involves, heating of steels to above the critical temperature range (for hypo-eutectoid steels) or within the critical range (for hyper-eutectoid steels) holding at that temperature for required span of time and cooling at a rate faster than the critical cooling velocity there by rendering the steel with hard and brittle martensite structure.

CASE HARDENING:-

In this process the metal, that undergoes such treatment, forms a hard surface with comparatively soft core. This is done to steel having a carbon percentage less than 0.3%, which does not accepts normal hardening procedure. Case hardening is normally to a depth of 0.5mm to 0.9mm.

PROCESS PLANNING CHART FOR MAIN PARTS

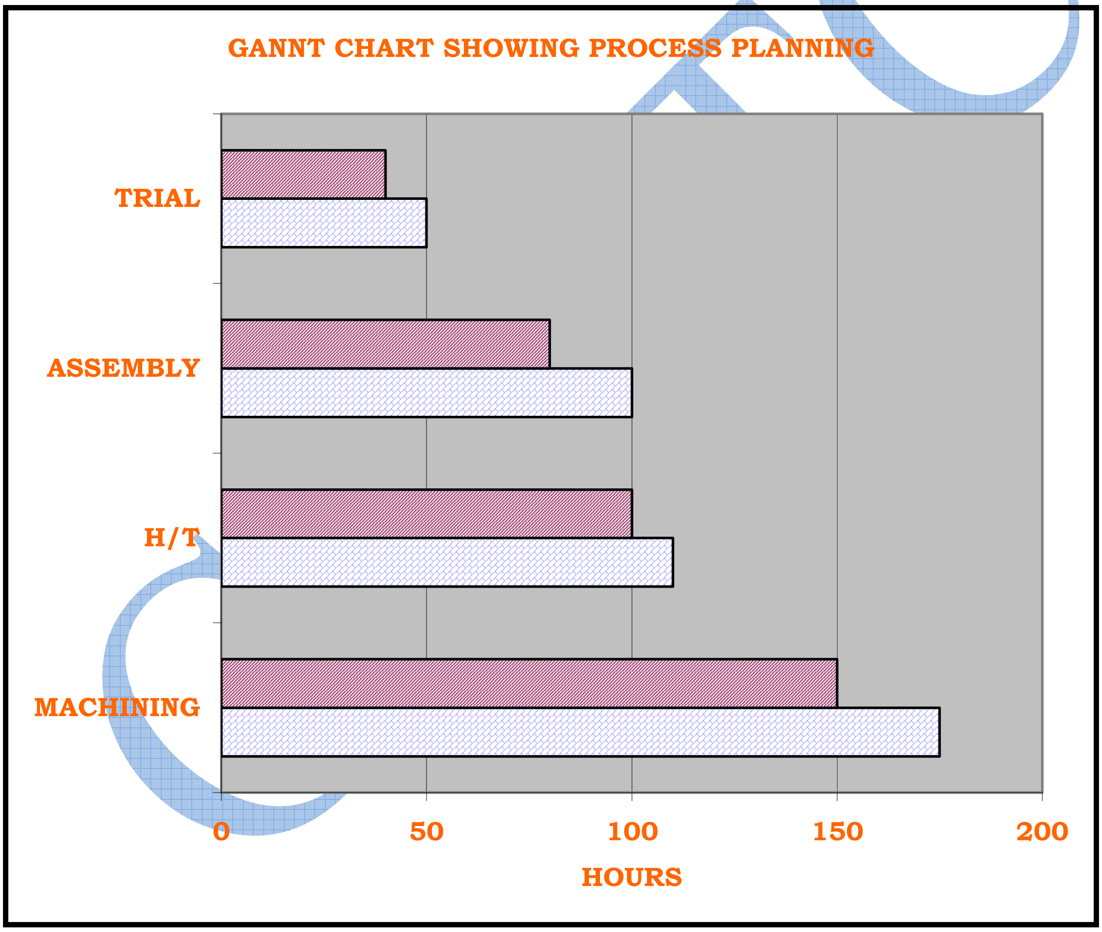
SL no	PART NAME	OPERATION DESCRIPTION	MACHINE
01	Main cavity	**1.** Collect from the mould base and milling. **2.** Thickness maintaining in the surface grinding. **3.** CNC milling for fin's profile milling using ball nose cutters. **4.** Sparking of the fin profile edges for sharp and accurate corners. **5.** Inspection of the pitch's.	STD BFW **PROTH** MAKINO CHAMER CMM
02	Main core insert	**1.** Raw material from ASSAB. **2.** Milling, sizing and drilling in conventional milling. **3.** Thickness maintaining in surface grinding. **4.** CNC milling for center circular pocket and fin profile milling. **5.** WEDM for ejector pin holes. **6.** Sparking for fin profile and sharp edges.	BFW JUNG MAKINO MAKINO ELECTRONICA

SL no	PART NAME		MACHINE
03	Core insert	**1.** Raw material from ASSAB. **2**. Milling, sizing and drilling in conventional milling. **3.** Thickness maintaining in surface grinding. **4.** CNC milling for center circular pocket and fin profile milling. **5.** WEDM for ejector pin holes. **6.** Sparking for fin profile and sharp edges. 7. Inspection of the profiles.	 BFW PROT MAKINO MAKINO CHAMER CMM

REFERENCE CHART:

REFERENCE CHART SHOWING PROCESS PLANNING.

Y-HOURS TO X-OPERATION

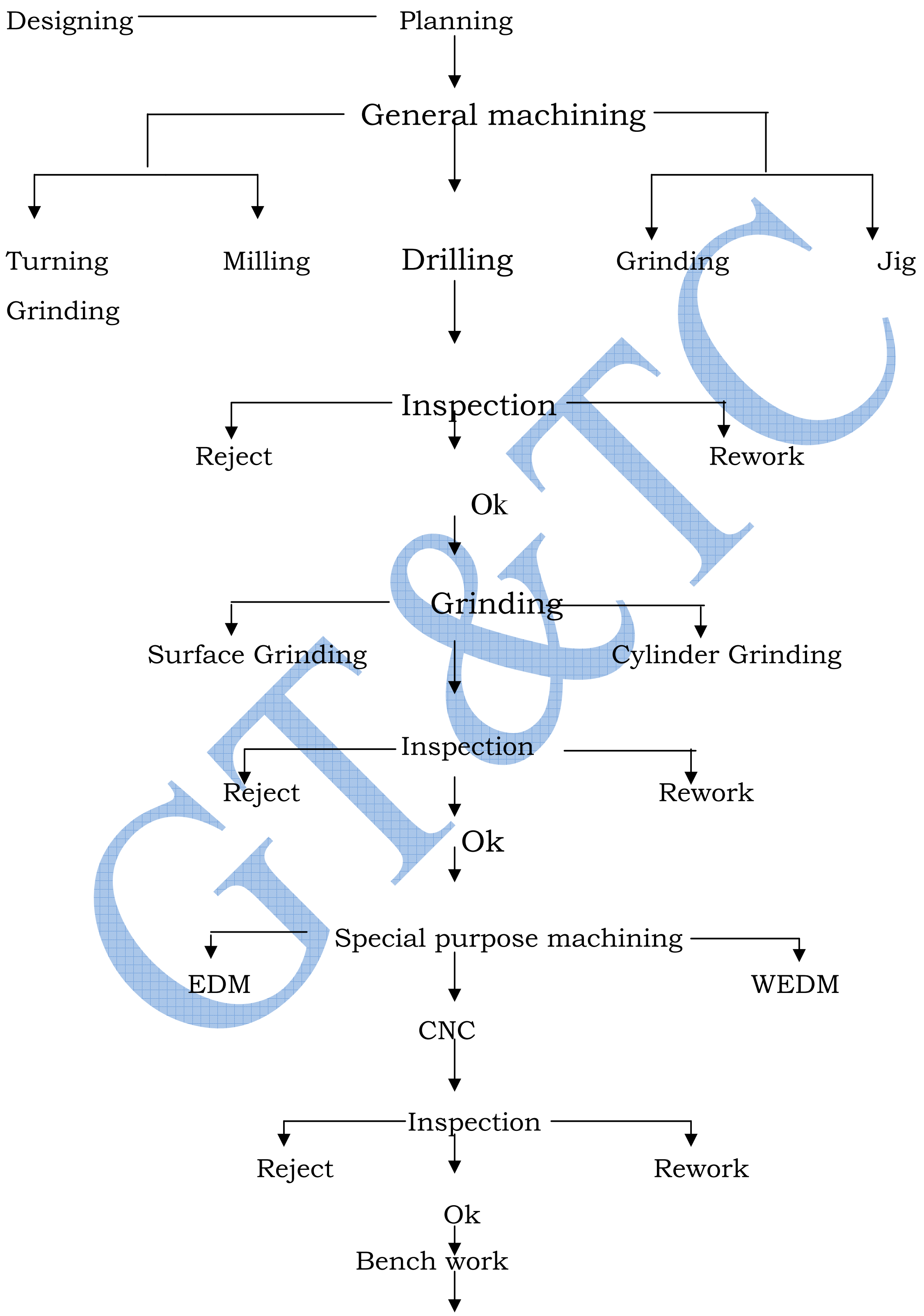


GANNT CHART:

Henry and GANNT developed the GANNT chart, where the load is marked against a time scale with one horizontal line allotted to each machine.

DESIGNING	X	X																			
R M PROCESS			X																		
PRE TOOLING			X	X																	
TURNING				X	X																
MILLLING				X	X	X															
HEAT TREATMENT						X															
SG						X	X	X													
CG							X	X													
ELECTRODE MFG							X	X													
EDM									X	X	X	X									
WEDM												X	X								
POLISHING														X	X						
ASSEMBLY																X	X	X			
TRYOUT																			X	X	
	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
								Days													

FLOW CHART FOR METHODICAL TOOL MAKING



Assembly

Try out

Rejection | ok | Rework

Dispatch

FLOW CHART FOR MOLDINGPROCESS

Receive the raw material

Receiving inspection

Storage in molding shop

Pre drying plastics resin in dryer

Mould set up

Inspection

Production

Inspection

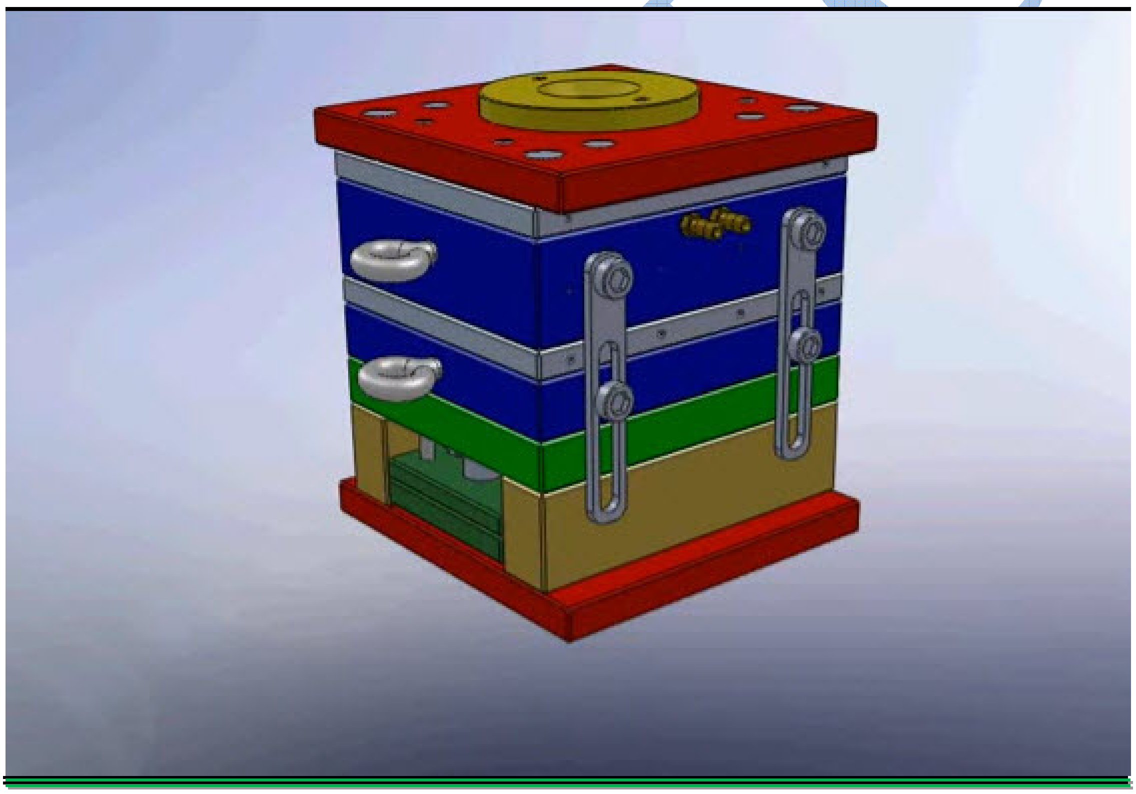
Assembly

Final inspection

Packing

Dispatch

TOOL MANUFACTURING PROCESS



TOOL MANUFACTURING PROCESS

Then Manufacturing of main parts such as core inserts, cavity inserts, side cores, side core holders etc are carried out in tool room using conventional & non-conventional machines such as Milling, Grinding, sparking, WEDM. Even after the completion of particular operation stage inspection will be carried out using measuring instruments such as venire, micro meters, gauges etc to check whether machined profiles are within speck.

The injection mould for Hooter Buzzer Holder was well planned and processed as per the design and planning and completed within estimated time.

The manufacturing process of the mould was divided into 2 parts

The mould box

Core and Cavity

1) Mould Box :

For this tool the mould box plates are ordered & then profiles are manufactured in CNC machine.

2) Manufacturing of Round Items.

3) Manufacturing of Core and Cavity.

4) Manufacturing of Electrodes

2. MANUFACTURE OF ROUND ITEMS

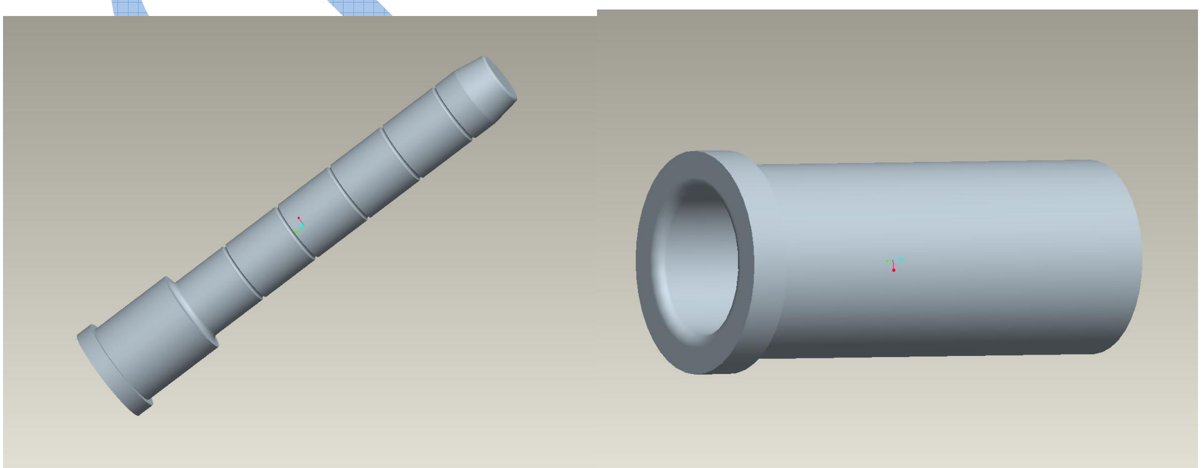
- ❖ Guide pillar
- ❖ Guide bush
- ❖ Locating ring

Raw material of all round items ware procured and then turned with 0.5mm grinding allowance, except locating ring that was finished to drawing dimensions. Their respective heat treatment operations were performed and inspected for hardness and then were cylindrical ground to the drawing dimensions.

Guide pillar

Tool room work.

- ➢ Reference grinding
- ➢ Drilling of counter bore
- ➢ Step milling
- ➢ Heat treatment
- ➢ Grinding to fitting dimension.



Guide Bush

Tool room work.

- Drilling & tapping
- Angle milling
- Heat treatment
- Grinding to fitting dimension

Locating ring

Tool room work.

- Step turning.
- Heat treatment.
- Head grinding with step.
- Final height maintaining

3. A) Core Plate:

Material: P20

QTY : 01 No

Raw material of size 300x300x40 is cut and moved to pre tooling. Here the dimension is maintained to 298x298x38 living the allowance for grinding. Then these inserts are ground to maintain the right angle. Then screw holes, cooling holes, ejector relief holes…etc are drilled as per drawing.

After the bench, it is sent for heat treatment. After heat treatment the plate is once ground to maintain right angle and is moved further to the Wire cutting section for profile opening operations. This plate has edge gate and parallel cooling. After all the operation done from CNC the plate is sent for inspection.

Tool room work.

- Drilling and boring of insulating bush hole.
- Milling of slide area.
- Spotting drilling and tapping of screw holes at the back.
- Drilling and tapping of Cooling holes
- Heat treatment.
- Grinding (just clean)
- Wire cutting of cavity insert, reference hole for sparking.
- Grinding slide area. Sparking component area.
- Grinding to fitting size.

1. b) Cavity Plate:

Material : P20

QTY : 01 Nos.

Raw material of size 300x300x40 is cut and moved to pre tooling. Here the dimension is maintained to 298x298x38 living the allowance for grinding. Then these inserts are ground to maintain the right angle. Then screw holes, cooling holes, ejector relief holes are drilled as per drawing.

After the bench work the plate is moved to CNC for milling operations. Then it is sent for heat treatment. After heat treatment the plate is once ground to maintain right angle and is moved further to the CNC section for the milling and sparking operations. This plate have edge gate and parallel cooling. After all the operation done from CNC the plate is sent for inspection.

Finally the cavity is polished to remove the milling marks and sparking marks, to get the required finish on the component.

Tool room work.

- Drilling and boring of insulating bush hole.
- Milling of slide area.
- Spotting drilling and tapping of screw holes at the back.
- Drilling and tapping of Cooling holes
- Heat treatment.
- Grinding (just clean)
- Wire cutting of cavity insert, reference hole for sparking.
- Grinding slide area. Sparking component area.
- Grinding to fitting size.

Manufacturing of electrodes: -

It is the most vital part in processing of core and cavity for any tool, which requires material removing by spark erosion.

The material used, as electrodes will have good electrical conductivity like Graphite, Tungsten Copper . In this tool, Copper is used for roughing and finishing operations. The profiles of electrodes were made slightly less than the required profile on the insert in over all dimensions, which are known as spark gap.

It is intentional difference (gap) between the electrodes and the required profile which will be sparking eroded in the insert later on. Spark gap is given in mm/side

- Pre-machining is carried out as per drawing.
- Thickness is ground for parallelism and screw holes are drilled and tapped as per the required pitches.
- Profile is wire cut as per drawing.

Finally electrodes are polished before spark erosion is carried out.

In this tool spark gap is taken as:

Roughing : 0.250mm/side

Semi finishing: 0.150mm/side

Finishing : 0.050mm/side

Fine finishing : 0.025mm/side

For this mold the electrodes are made for:

a. Cavity profile.
b. Core profile.
c. Side core area in the core.
d. Component profile in the slides.
e. Component profile in the side core pin.

Manufacturing process of the part

Runner block

- The raw material is pre-machined and then grounded to the size.
- Runner portion will be sparked and finished with polishing.
- Radius will be provided more than the radius of nozzle by sparking.

spacers

- The raw material is pre-machined.
- Clamping holes and extraction hole are drilled and tapped.
- Step mill the clamping portion of the wedge and spacer.
- The part is sent for heat treatment.
- Then it is ground to the required size.

Core and Cavity profile is complicated, so the core and cavity designed into Inserts for easy manufacturing.

- All the core and cavity inserts are pre-machined considering the allowance for the grinding.
- Shoulder and slots should be milled.
- Drill the holes for ejector pins with allowance.
- Profile surface of the inserts made by cnc milling with allowance
- Insert blocks are sent for hardening.
- Shoulder and slots should be finished by grinding to the required size.
- Finish the ejector and insert holes by Wire cutting.
- Profile surface of the inserts should be sparked.
- Finally impression surface are polished

Machinery Used for particular operation:

Sl. No.	Machinery Used	M/c make
01	CNC Milling	Macron
02	Surface Grinding	Mitsui
03	EDM	Sodick
04	WEDM	Sodick

Software Used:

Autocad2007
Pro-e

Insert Inspection;

During each stage of operation initial inspection will be carried out to avoid wastage of machining time and money,even man power will be wasted.

Inspection carried out during Manufacturing:

Sl.No	Operation Stage	Instrument Used
01	Pre-Tooling (Millling)	Vernier Calliper
02	After Heat Treament	Hardness Testing Machine
03	Grinding	Digital Micro Meter & Venier, Linear height Gauge, Charmer etc...
04	EDM & WEDM	Profile Projector, Charmer etc...

Specifications of Machine

Name : ANGLE150
Screw diameter : 22mm
Maximum injection volume : 29cm^3
Maximum injection pressure : 260 MPa
Maximum pack pressure : 260 MPa
Maximum injection speed : 200mm/s
Maximum screw rotation speed : 300 min^{-1}

Clamping Unit

Tonnage	:150ton
Maximum die height	: 450mm.
Minimum die height	: 150mm.
Tie bar spacing (HxV)	: 460x410mm.
Overall size of platens	: 660x610mm.
Ejection stroke	: 100mm.
Ejection force	: 25KN.
Clamping stroke	: 350KN.

TYPE OF FIT IN THIS MOULD

Sl No.	DESCRIPTION	TYPE OF FIT	
1	Main guide pillar-main guide bush	Close running fit	H7/g6
2	Main guide pillar-housing	Light key fit	H7/k6
3	Core pin – Core insert	Light key fit	H7/k6
4	Cavity insert- housing	Light key fit	H7/k6
5	Push back pin –core plate	Close running fit	H7/g6
6	Ejector pin – core insert	Close running fit	H7/g6
7	Cavity insert – cavity insert	Light key fit	H7/k6
8	Alignment bush – housing	Slide fit	H7/h6
9	Ejector guide pillar- housing	Medium drive fit	H7/m6
10	Ejector guide pillar- guide bush	Close running fit	H7/g6
11	Ejector guide bush –ejector plate	Medium drive fit	H7/m6
12	Register ring – housing	Running fit	H7/f6
13	Register ring – machine platen	Running fit	H7/f6
16	Wedge block – housing	Light key fit	H7/k6

ELECTRODE MANUFACTURING & SPARKING

- The material being used for electrode is COPPER.
- The electrode material is clamped by means of screws in the standard brass electrode holder. This in turn is held in EROWA holder for machining.
- The machining is done in CNC milling machine (MAKINO). Simpler profiles are milled by programming manually.
- The complicated profiles such as component profile, 3D profile are milled using CAM.
- The CAM software being used is ESPIRIT.
- Sparking is done in CNC sparking machine (ROBOFORM 20 - CHARMILLES TECHNOLOGIES)

FOR THIS MOULD THE ELECTRODES ARE MADE FOR;

a. Cavity profile.
b. Core profile.
c. Side core area in the core.
d. Component profile in the slides.
e. Component profile in the side core pin.
f. On ejector pins.

For all the above, a set of three electrodes are made with three spark gaps.

1.Roughing electrode with 0.30/side spark gap.
2.Semi-finishing electrodes with 0.10/side spark gap.
3.Finishing electrodes with 0.05/side spark gap.

1.Roughing Electrodes;

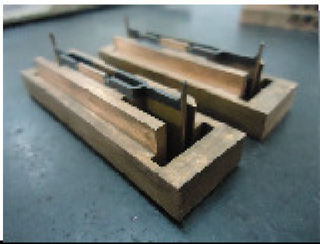
Roughing electrodes are used for plunge cut (Direct sinking mode). Roughing operation is done using a program, starting with 0.30/side spark gap and ending with 0.10 spark gap. The RA value achieved after this operation is 1.60 microns.

2.Semi-finishing Electrodes;-

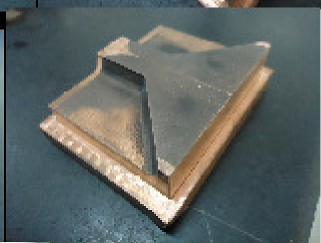
Semi-finishing electrodes are also used for plunge cut . Semi-finishing operation is done by using a program, starting with 0.17/side spark gap and ending with 0.025spark gap. The RA value achieved after this operation is 1.0microns.

3.Finishing Electrodes;-

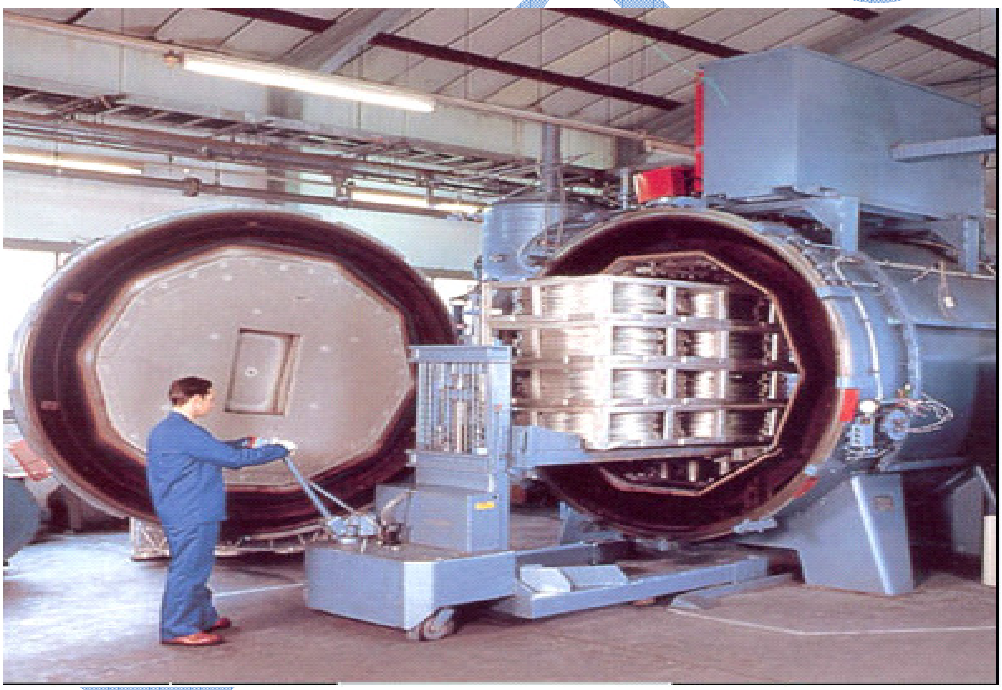
Finishing electrodes are used for orbital machining. Finishing operation is done using a program starting with 0.025/side spark gap and ending with 0.005/side spark gap. This operation is done to get good surface finish. The RA value that can be obtained with this operation is 0.40microns






HEAT TREATMENT



HEAT TREATMENT

Process of heat treatment:-

Heat treatment is a process of includes desired mechanical properties like wear resistance, corrosion resistance, and mach inability and also to reduce internal stresses setup due to hot or cold working of steel. Heat treatment consists of following three steps.

Heating:

Heating involves increasing the temperature of steel to desired temperature.

Soaking:

The steel is held at this temperature for a period of time called soaking period. This result in formation of homogeneous austenite, throughout the structure.

Cooling or Quenching:

Quenching is done to cool the parts rapidly and to transform the austenite to marten site structure without allowing the formation of pearlite. Some of the quenching media are water, oil or salt bath etc…

THE FOLLOWING ARE THE METHODS OF HEAT TREATMENTS AND THEIR PROCESS TEMPERATURES.

Sl.No.	Description	Temperature	Cooling Media
1.	Annealing	30 ^{0} C – 50^0 C	Air cooling
2.	Normalizing	30 ^{0} C – 50^0 C	Air cooling
3.	Hardening	30^0 C – 50^0 C	Water or oil in molten salt bath
4.	Tempering	200 ^{0} C – 600^0 C	Air cooling

PURPOSE OF HEAT TREATMENT:

1. To increases the hardness of metal or to soften the metal.
2. To relive internal stress this may be developed during m/c process.
3. To improve resistance to heat and corrosion.
4. To change the grain size and structure.
5. To alter the structure of metal and there by improve its mechanical properties such as strength hardness, toughness, shock resistance, tensile strength, ductility etc.
6. Modify electrical & magnetic properties.

DIFFERENT TYPES OF HEAT TREATMENT:

1. Annealing.
2. Normalization.
3. Hardening.
4. Tempering.
5. Case (Surface) Hardening.
6. Diffusion Coating.

HARDENING:

Hardening is a process done to develop hardness, wear resistance and to enable it to cut other material.

THE PROCESS CONSISTS OF:

1. **Heating the steel to a temperature above critical point.**
2. **Holding at this temperature for a considerable period.**
3. **Quenching (Rapid Cooling) in water, oil or in molten salt bath.**

SURFACE HADENING:

Surface hardening is a heat treatment process in which only the surface layer is hardened to a certain depth leaving the core of the work unhardened.

The main purpose of surface hardening is to increase the hardness, wear resistance of the surface of the metal components.

The core remains tough, ductile and it can

Withstand impact loads. The different processes in use for case hardening are.

1. Carburizing.
    - Pack Carburizing.
    - Liquid Carburizing.
    - Air Carburizing.
2. Cyaniding.
3. Nitriding.
4. Flame Hardening.
5. Induction Hardening.

DIFFUSION COATING:

Diffusion coating is the process of impregnating the surface of steel with Aluminum Chromium, Silicon, Boron Belgium and other metal.

Diffusion Coating is accomplished by holding steel parts in direct contact with one of the above element to increase the wear resistance, corrosion properties.

TEMPERING:

The structure obtained after hardening is hard wear resistance and externally brittle. Because of brittleness the toughness is very little hence; it cannot be used for engineering applications. Some amount of hardness must be a sacrificed to obtain suitable toughness & ductility. This can be achieved by the process called Tempering.

Tempering comprises of heating the hardened steel to suitable temperature (below the lower critical temperature) followed by cooling in Oil, Water or Air.

PURPOSE OF TEMPERING:

⇒ To stabiles the structure of steel.
⇒ To reduce internal stress produced during previous heating.
⇒ To increase toughness & shock resistance.

ANNEALING:

OBJECTIVES:

* Softening the metal to improve machine ability.
* Relive at that temperature.
* To refine grain size.

PROCESS:

- Heating slowly about 30º to 50º c.
- Holding at that temperature.
- Cooling slowly.

NORMALSLING:

OBJECTIVES:

* Refine grain structure.
* Remove strains caused by the cold working.
* To obtained yield strength, impact strength, ultimate tensile strength.

PROCESS:

- Heated for a considerable period above critical temperature.
- Cooling in air.

PACK CARBURIZING:

OBJECTIVES:

To introduce carbon into surface of low carbon steel.

PROCESS:

Steel is packed in steel boxes in presence of charcoal and heated up to 900^{o} C to 950^{o} C.

NITRIDING:

OBJECTIVES:

To obtain harden surface with no distortion no stresses and no considerable change during heat treating process.

PROCESS:

- Heating steel parts in the atmosphere of ammonia containing high concentration of nitrogen at about 570^{o} C.
- Allowed to cool slowly.

CYANIDING:

OBJECTIVES:

To produce hard surface on low and medium carbon steel.

1. Steel is kept in salt bath containing cyanide at a temperature of 900^{o} c.
2. Quenched in oil or water.

INDUCTION HARDENING:

In this method analysis of the surface steel is not changed. Here a high frequency current of about 2000 Hz is passed through copper block which is placed around the job without

touching it, hardening temperature is about 750° C to 800° C. Then heated area is quenched by spray of water. A depth of case about 3 mm obtained is 5 second.

FLAME HARDENING:

The process of hardening steel is heated with the flame of an oxyacetylene gas. The flame is directed to the desired part without heating the remainder of the work the rapid heating is followed by quenching in water. The depth of hardness depends upon time.

HEAT TREATMENT OF D2(HCHCR) (wedge,straight lock,guide rail,side core)

SOFT ANNEALING

Protect the steel and heat through to 900°C(1650°F). Cool in the furnace at 10°C (20°F) perhour to 750°C (1380°F), then freely in air.

STRESS RELIEVING

After rough machining the tool should be heated through to 650°C (1200°F), holding time 2 hours. Cool slowly to 500°C (930°F), then freely in air.

HARDENING

Pre-heating temperature: 600–700°C (1110–1290°F)
Austenitizing temperature: 1020–1100°C (1870–2010°F)
Holding time: 30 minutes.
Holding time = time at hardening temperature after the tool is fully heated through. A holding time of less than 30 minutes will result in loss of hardness.
The tool should be protected against decarburization and oxidation during hardening.

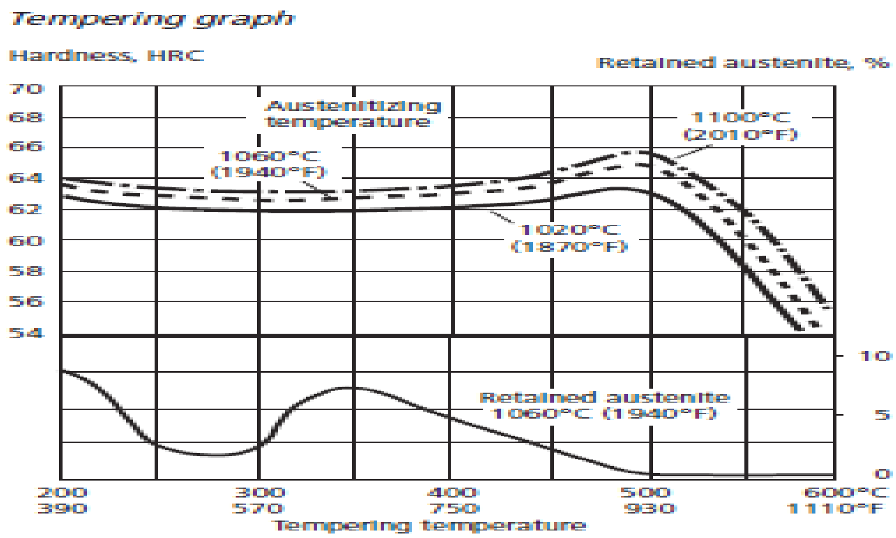
QUENCHING MEDIA

- Forced air/gas
- Vacuum furnace (gas overpressure 2–5 bar)
- Mar tempering bath or fluidized bed at 500–550°C (930–1020°F)
- Mar tempering bath or fluidized bed at 200–350°C (390–660°F) whereby 350°C (660°F) is Preferred.

Note 1: Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).
Note 2: In order to obtain the optimum properties for the tool, the cooling rate should be as fast as is concomitant with acceptable distortion.
Note 3: Tools with sections >50 mm (2") should be quenched in forced air. Quenching in still air will result in loss of hardness.

TEMPERING

Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper twice with intermediate cooling to room temperature. Lowest tempering temperature180°C (360°F). Holding time at temperature minimum 2 hours. At a hardening temperature of1100°C (2010°F) or higher Vanadis 10 should be tempered at minimum 525°C (980°F) in order to reduce the amount of retained austenite



HEAT TREATMENT OF AISI A2 (1.2363)

(sprue bush,finger cam,wear plates, rest button).

SOFT ANNEALING

Protect the steel and heat through to 1560°F (850°C). Then cool in the furnace at 20°F (10°C)per hour to 1200°F (650°C), then freely in air.

STRESS RELIEVING

After rough machining the tool should be heated through to 1200°F (650°C), holding time 2 hours. Cool slowly to 930°F (500°C), then freely in air.

HARDENING

Preheating temperature: 1200–1380°F (650–750°C).
Austenitizing temperature: 1700 –1780°F (925–970°C) but usually 1720–1760°F (940–960°C).

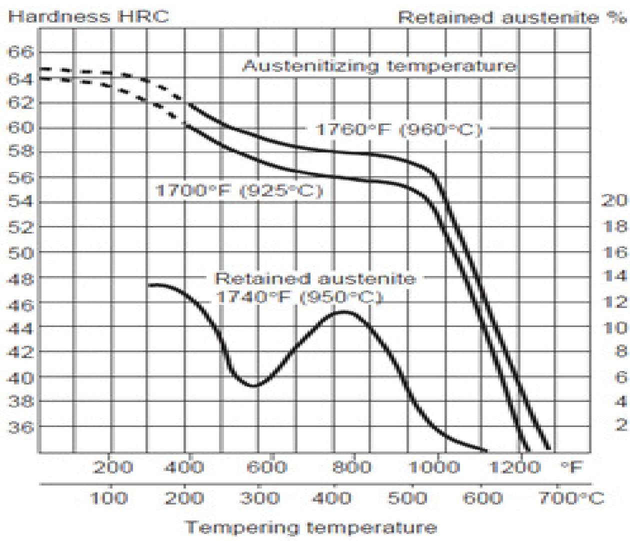
Temperature		Soaking* time min.	Hardness before Tempering
°F	°C		
1700	925	40	approx. 63 HRC
1740	950	30	approx. 64 HRC
1780	970	20	approx. 64HRC

QUENCHING MEDIA

- Mar tempering bath or fluidized bed at 360–430°F (180–220°C) or 840– 1020°F (450–550°C)then cool in air
- Circulating air or atmosphere
- Vacuum furnace with overpressure of gas at cooling
- Oil (only for small and uncomplicated tools).

TEMPERING

Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper twice with intermediate cooling to room temperature. Lowest tempering temperature360°F (180°C). Holding time at temperature minimum 2 hours.

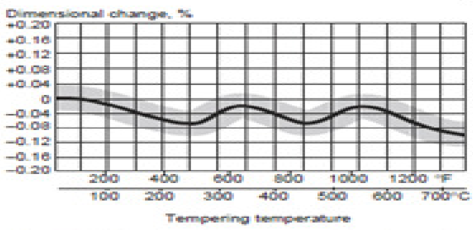


DIMENSIONAL CHANGES DURING HARDENING

Sample plate, 4" x 4" x 1", 100 x 100 x 25 mm.

	Width %	Length %	Thickness %
Oil hardening from 1760°F (960°C) min.	–0.10	–0.02	±0
max.	–0.05	+0.06	–0.05
Martempering from 1760°F (960°C) min.	+0.04	+0.06	±0
max.	+0.05	+0.08	+0.04
Air hardening from 1760°F (960°C) min.	+0.08	+0.13	±0
max.	+0.14	+0.15	+0.04

DIMENSIONAL CHANGES DURING TEMPERING



Note: The dimensional changes on hardening and tempering should be added together.

HEAT TREATMENT OF CALMAX (core&cavity inserts)

SOFT ANNEALING

Protect the steel and heat through to 860°C(1580°F), holding time 2h. Cool in furnace20°C/h to 770°C (35°F/h to 1420°F), then10°C/h to 650°C (18°F/h to 1200°F) and subsequently freely in air.

STRESS RELIEVING

After rough machining the tool should be heated through to 650°C (1200°F), holding time 2h. Cool slowly to 500°C (930°F), then freely in air.

HARDENING

Preheating temperature : 600–750°C (1110–1380°F).

Austenitizing temperature: 950–970°C (1740–1780°F), normally 960°C (1760°F).

Temperature		Holding time min.	Hardness before tempering
°F	°C		
1740	950	30	62 HRC
1760	960	30	63 HRC
1780	970	30	64HRC

QUENCHING MEDIA

- Forced air/gas
- Vacuum furnace with sufficient overpressure
- Mar tempering bath or fluidized bed at200–550°C (320–1020°F) followed by forced air cooling
- Oil.

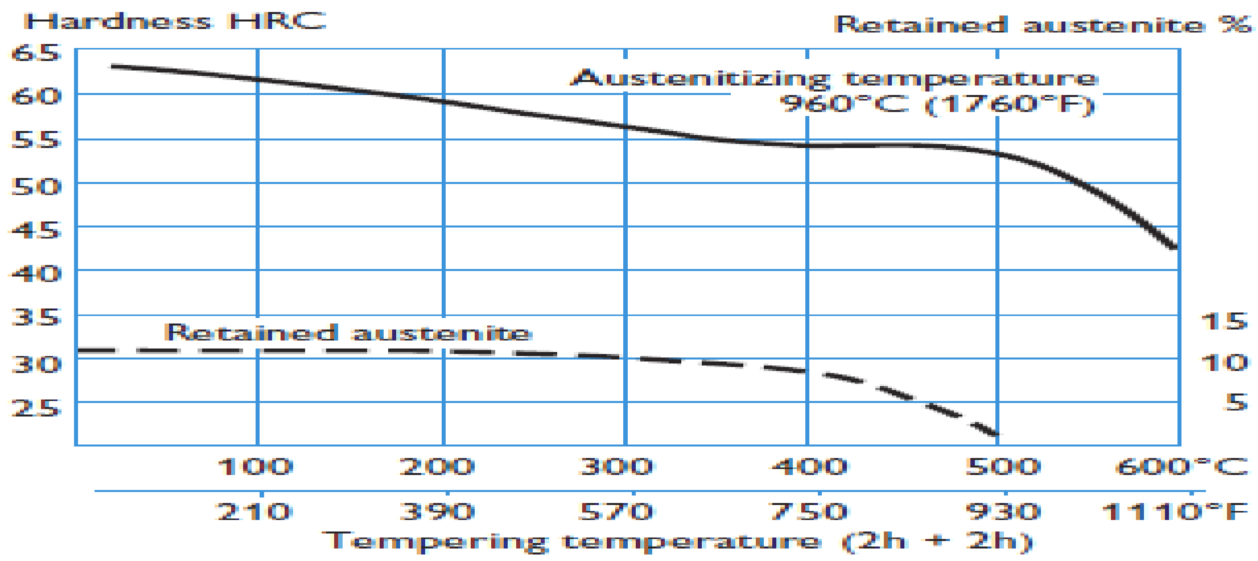
Note 1: Quenching in oil gives an increased risk for dimensional changes and cracks.

Note 2: Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

TEMPERING

Choose the tempering temperature according to the hardness required by reference to the tempering graph. Temper twice with intermediate cooling to room temperature. Lowest tempering temperature 180°C (360°F). Holding time at temperature minimum 2h.

TEMPERING GRAPH



HEATTREATMENT OF 1.2767

SOFT ANNEALING

Protect the steel and heat through to 610 to 650°C. Then slow cooling in the furnace at 20°F (10°C) per hour to 1200°F (650°C), then freely in air.

STRESS RELIEVING

After rough machining the tool should be heated through to 1200°F (650°C), holding time 1-2 hours. Cool slowly to 930°F (500°C), then freely in air.

HARDENING

Austenitizing temperature: 840–870°C.
Holding time after temperature equalization:15 to 30 minutes.

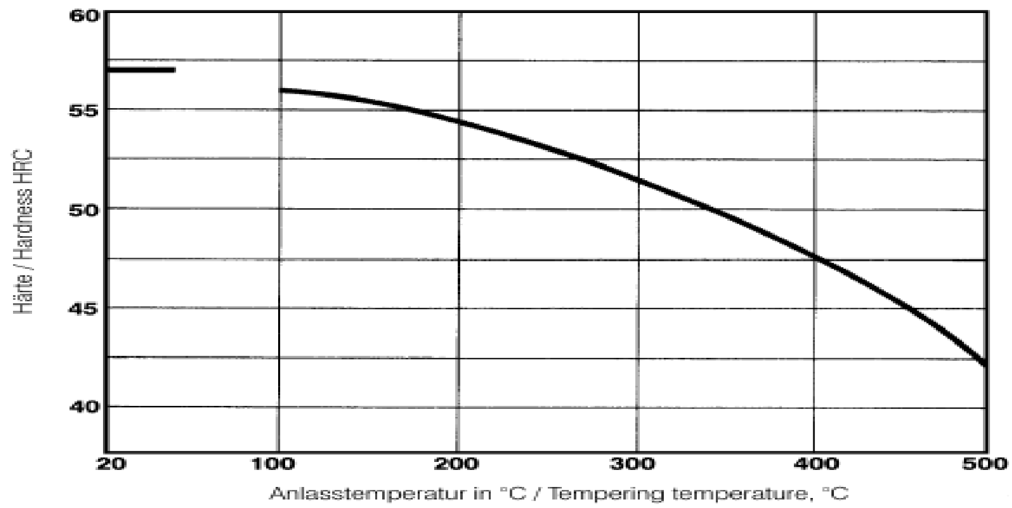
QUENCHING MEDIA

• Oil, Air and Salt bath at 300–400°C

Obtainable hardness:
53 - 57 HRC in air, 54 - 58 HRC in oil or salt bath.

TEMPERING

Slow heating to tempering temperature immediately after hardening/time in furnace 1hour for each 20 mm of workpiece thickness but at least 2hours/cooling in air. For average hardness figures to be obtained please refer to the tempering chart. For certain cases were commended to reduce tempering temperature and increase holding time.



60
55
50
45
40
Härte / Hardness HRC
20
100
200
300
400
500
Anlasstemperatur in °C / Tempering temperature, °C

POLISHING

POLISHING

It is an art of obtaining high gloss finish on to a ground or sparked surface. The surface finish achieved in core and cavity will be reflected on to the component. In an injection mould, the core and cavity, for some component like optical lens etc, a very high finish is required, so polishing of core and cavity in an injection mould is necessary

Purpose of polishing is to remove the weak layer of the metal caused due to the stress induced by machining. This process is generally applied for free flow of molten materials into the cavities and enables easy ejection of component**.**

Advantages of Polishing:

- Good surface finish.
- Easy flow of the material.
- To reduce risk of local corrosion.

PROCESS OF POLISHING

First with the help of coarse oil stone or using grinding wheel powder eliminates the marks of machining. After the machined marked are removed, emery paper is used for polishing. Starting with coarse grade of emery, polishing proceeds with finer grades of emery. For each grade of emery is used the previous polished have to be eliminated and the surface layer has to be altered for each polish. Finally diamond paste of fine grade is applied to impart a high finish

MOULD POLISHING PROCEDURE

POLISHING TOOLS

Oil stones, emery sheets, Silicon carbide, diamond compound Past, coconut oil, peg wood sticks, cotton tissue paper, white grease etc.

POLISHING , INGREDIENTS used

- Oil STONE.
- Emery Sheet.
- Diamond paste.
- Silicon Carbide

Oil Stone Grade

- Am-8 120-600 (white aluminum oxide)
- Ao 220 (white aluminum oxide)
- AB-s600 (Al oxide resin bond)
- 900F (levitated alumina)

Emery Sheets

Grade:

400, 500, 600, 800, 1000, 1/0, 2/0, 3/0, 4/0(silicon carbide)

- 400,500 for medium deep scratch
- 600 finer than the valve
- 800,1000 for finer scratch
- 1/0 to 4/0 for silky finish

Silicon carbide Available in the form of:

- Silicon stick or blocks.
- Loose grain or powder.
- Impregnated paper or cloth.

Diamond Compounds

Diamond compounds are normally classified in micron grades. They are available in the form of paste or powder. They are hardest forms of abrasives.

GRADE:

45STD, 25, 14, 14, 8, 6, 3, 1STD (Blend of natural diamond).

45Std is rough and 1Std is very fine.

SERIES

45STD = For fine pre polishing marks

1 o 3STD=For paper scratch, fine glossy finish

1 =for final scratch free mirror polish surface

SEQUENCE

a. FOR SPARK EDM SURFACE
b. Mainly 120 oil stone and continuing
c. FOR GRINDING SURFACE

Mainly 400 oil stone and continuing.

Lubricant used in polishing

- Light spindle oil
- Mixture of paraffin and light oil.
- Kerosene

Care of polished surface

1. Apply grease, antirust sprays and anti rust compounds to avoid
2. oxidation.
3. Preserve polished items in dust free places.
4. Should not touch with bare hands.

Note:

The surface roughness expected from the polishing process is from 0.04-0.16□

In this tool component area of core, cavity insert, side cores and local inserts were polished as per requirement. Runner and sprue were also polished for easy removal of feed system.

HOW TO JUDGE THE SURFACE QUALITY !

Two things are important when judging the surface of the mould:
First, the surface must have a correct geometrical shape without any long microwaves which will mostly be an inheritance from early grinding and stoning steps.
Secondly the mirror finish of the mould surface is judged by naked eye. The surface must be free from scratches, pores, orange peel, pitting etc. In more sophisticated cases, the finish can be judged by instruments.

POLISHING PROCESS:-

Polishing technique is also an important factor in tool making. Polishing operation can be done manually or by machine. Manually polishing requires a lot of skill and patience. It will be useless to attempt finish, untill all the stretches have been reduced to invisibility.

First machining marks are removed with the help of coarse oil stone. After the machining marks were eliminated coarse emery paper are used. Polishing proceeds with the grades of emery. In this process previous polishing marks have to be eliminated and the surface finish has to be improved in each polishing stage. Final buffing is done by different grade abrasive each time until required finish is achieved.

BUFFING

Buffing is used to give a much higher, lustrous, reflective finish that cannot be obtained by polishing. The buffing process consists in applying a very fine abrasive (usually diamond paste) with a rotating wheel. Buffing is made up of felts pressed and glued duck or cloths and also of leather.

Cleanliness is a critical factor in improving the productivity of the polishing department. and standard should be applied to both work piece and work place. Workplace must be cleaned thoroughly with soft tissue paper or a soft brush and kerosene. An effective tool for keeping the work free dust is by vacuum cleaner. Care must be taken of health while using abrasive paste and polishing powder

POLISHING PROBLEMS:

PITTING (NEEDLE-STICKS, PIN HOLES)

The very small pits which can occur in a polished surface generally result from slag inclusions in the form of hard, brittle oxides which have been torn from the surface by polishing process.

The causes are:

Polishing time and pressure.

Purity of steel, especially with regard to hard slag inclusions.

The polishing tool.

The abrasive.

One of the reasons why the pitting can occur is the difference in hardness between the material and the slag inclusion. During polishing, the material will be removed at a more rapid rate than the hard slag particles. Polishing will gradually "undermine" the slag particle until the particle is torn out of the material by further polishing. This leaves a pit on the polished surface.
If pitting occurs, the following measures are to be taken:

Regrind the surface carefully using next to last grinding surface prior to polishing.

Use a soft free cutting stone.

When using grain sizes lesser than 1omicrons, the softest polishing tool should be avoided.

Polish shortest possible time and under least possible pressure.

Avoid machine polishing with aluminium oxide paste.

ORANGE PEEL:-

The appearance of an irregular rough surface which is normally refered to as "orange peel" may depend on a number of different causes. The most common cause is overheating or over carburization from heat treatment in combination with high pressure and excessive prolonged polishing. The normal reaction of a person who sees that a surface has deteriorated is to increase the polishing pressure and continue polishing. This will result in further deterioration of the surface.

To restore the surface, stress relieve at a temperature of 25° C less than the last tempering temperature. Regrind the surface until the satisfactory surface is obtained. Start polishing again with a lower pressure than before.

SURFACE ROUGHNESS;-

Surface roughness is surface micro irregularities measured within small area and estimated in terms of accuracy and classes of surface finish. Roughness of machined surfaces is normally dependent upon machining accuracy that is higher grades of machining accuracy provide higher classes of surfaces finish. In some cases the surfaces of parts are machined with the aim of providing good appearance and accuracy (e.g. Core inserts, cavity inserts) other reasons may consist in preparing the surface for electro plating or making fine surfaces for sliding.

Representation of surface finish:

Roughness grade No	*Roughness value in μ*	*Roughness symbol*
N12	*50*	
N11, N10	*25, 12.5*	∇
N9, N8, N7	*6.3, 3.2, 1.6*	$\nabla\nabla$
N6, N5, N4	*0.8, 0.4, 0.2*	$\nabla\nabla\nabla$
N3, N2, N1	*0.1, 0.05, 0.0025*	$\nabla\nabla\nabla\nabla$

INSPECTION

INSPECTION

The measurement of the quality of the product in terms of prescribed standards is known as inspection. The product is specified in terms of surface roughness, dimensional accuracy, strength, chemical composition etc., Inspection plays an important role in tool making of manufacturing of any part. It seems that the manufactured component or part will have its own importance in a particular field in order to determine the fitness of anything made. Man has always used inspection.

The quality of any product can be measured in terms of standard items or drawings, this process is called inspection. In tool making, the quality of each part of the tool is reflected on the quality of the component. So inspection of the quality of each part process of manufacture is a must. This is called stage inspection.

But industrial inspection is recent origin and scientific approach behind it. It came into existence because of mass production, which involve interchangeability of parts. Lastly inspection leads to improvement in raw material manufacturing due to demands of high accuracy and precision. Inspection has also introduced spirit of competition and led to production of quality products.

Inspection of the core and cavity should be carried out thoroughly because any slight dimensional variation affects the accuracy of the components.

PURPOSE OF INSPECTION:

- To collect information regarding the performance of the product with established standards.
- To sort out poor quality manufactured products and thus maintain the standard.
- To establish and increase the reputation by protecting consumers from receiving bad products.

IMPORTANCE OF INSPECTION:

- Inspection traces defects in raw material, flaws in process, and those arising in production due to defective machinery or process.
- Inspection avoids further work on non finish parts already detected as spoiled
- Inspection ensures that quality of goods supplied to customers are up to mark

Generally used Inspection methods:-

Inspection can be categorized in respect to the method used.

1. Measurement: –

This involves determination of the numerical value of an instrument, vernier caliper, micrometer etc.

2. Go and no go checking: –

This involves the use of fixed limit gauges, pin gauges, and slip gauges.

3. Functional checking: -

It involves the testing of the function of a product inspection of fitting of guiding areas.

4. Visual inspection: -

This method involves the use of the human eye to judge the quality of product.

METHODS OF INSPECTION

There are mainly three types of inspection.

1. Floor inspection
2. Centralized inspection
3. Combined method of inspection

In floor inspection, the inspector walks around on the shop floor and inspects the jobs

In centralized type of inspection, all the jobs to be inspected are moved to a separate room for inspection. In combined method of inspection, shop floor and centralized inspection are combined together.

Combined method of inspection is used in our tool; because some parts are required to be inspected on the shop floor itself and some work piece are moved to the inspection room. Inspection is carried out in the shop itself for checking dimensions, which are not very important and accurate, and also which can be checked easily using instruments like vernier caliper, micrometer etc can be easily handled and used. This inspection includes checking of raw material size checking dimensions after roughing etc.

Some inspection cannot be carried out in shop floor like hardness checking of heat treated parts, checking of important profiles of core,

cavity and electrodes, which require some favorable conditions and precision instruments. This type of inspection is carried out in a separate room.

Inspection plays an important role in the success of a tool.

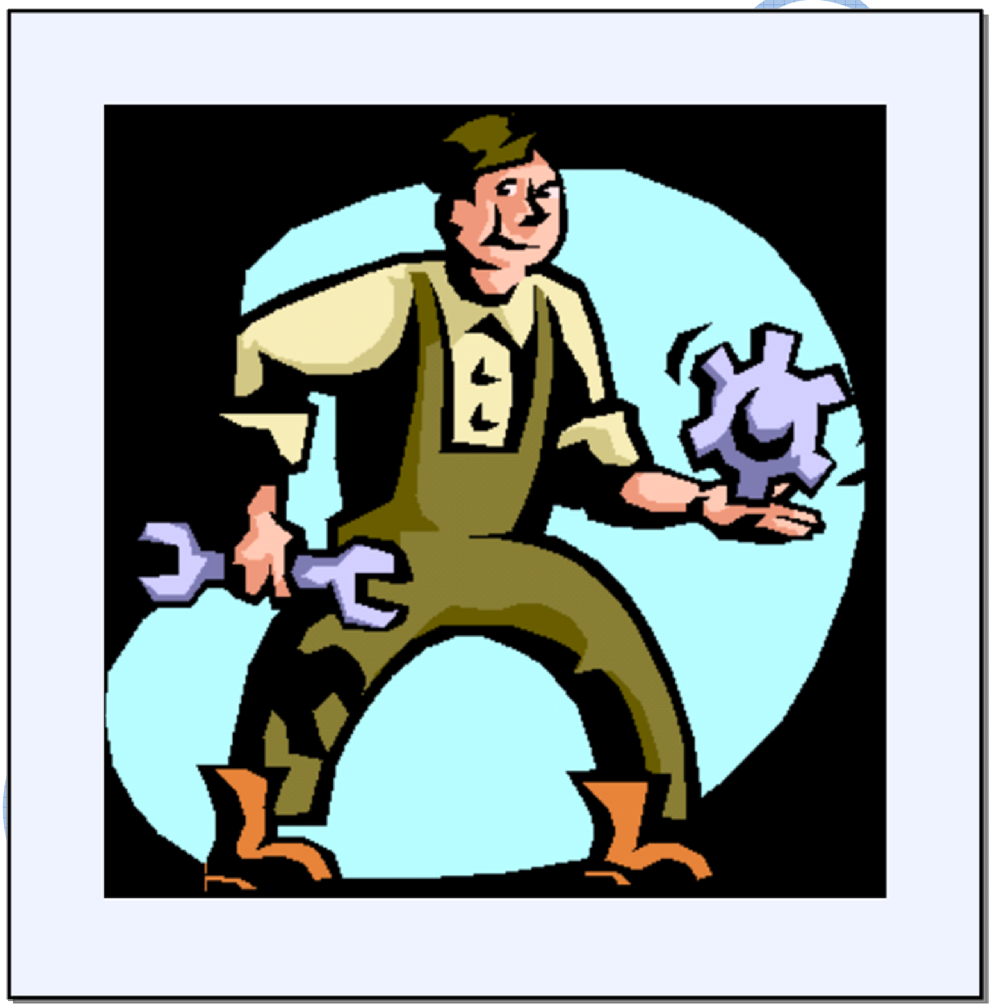
Some of the inspection instrument used in PRIMEX PLASTICS are:

- PROFILE PROJECTOR.
- TOOL MAKERS MICROSCOPE.
- TRIMOS.
- VERNIER CALIPER
- MICROMETER

Critical Dimension are measured by using

- PROFILE PROJECTOR.

ASSEMBLY



ASSEMBLY

Assembly is a high skilled operation, which is done by the toolmaker. The skill of the toolmaker is required in fitting in each part into the right place as per design to produce successful tool. The two important things to be kept in mind while assembling are care and cleanliness. If the care is not taken while handling the parts it leads to damages which in turn leads to loss of time and increases the cost of the mould.

MOULD ALIGNMENT

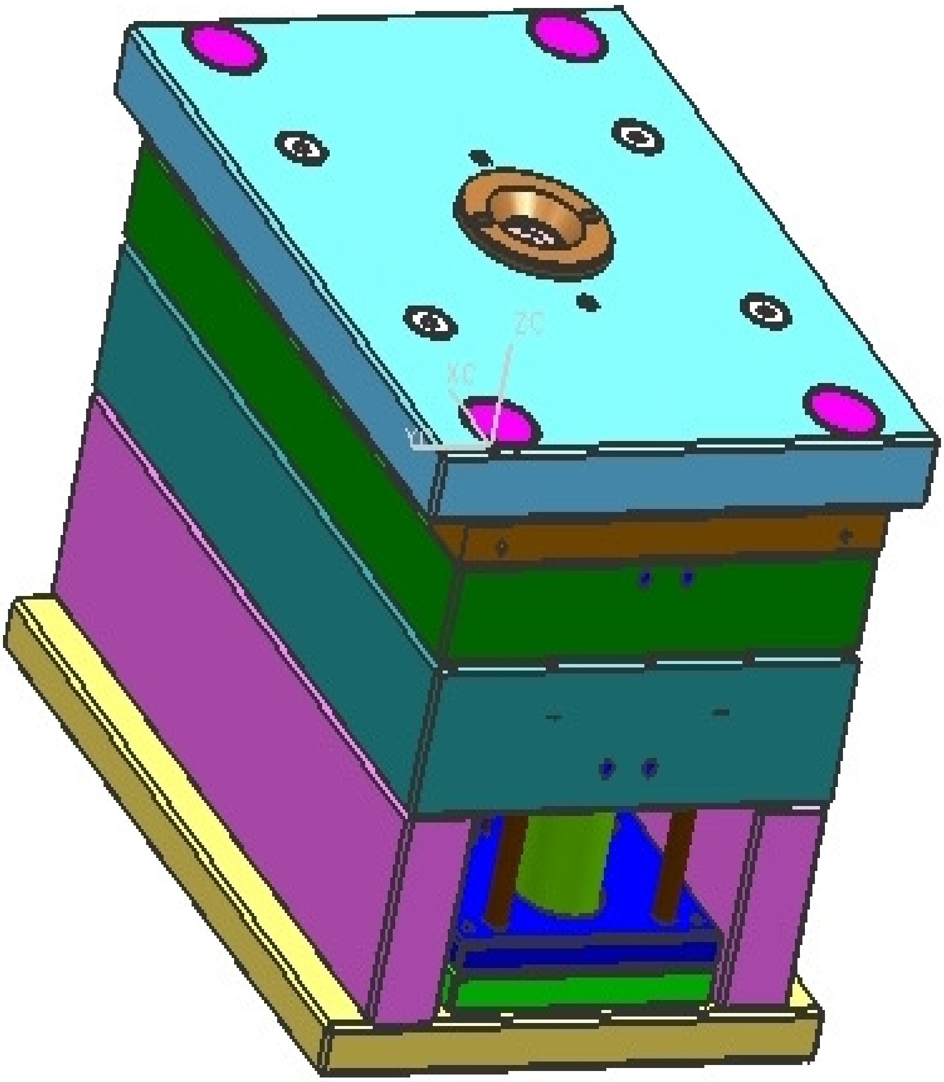
Before going for assembly of all the parts the mould box (mould base) should be checked for perfect alignment.

All the plates are clamped together as per design with pillars and bushes in their respective places. The other parts are not assembled. The Bottom half is placed on flat surface. A thin film of oil is applied to the sliding surface until the two halves butt on to each other. Then the halves are opened. .

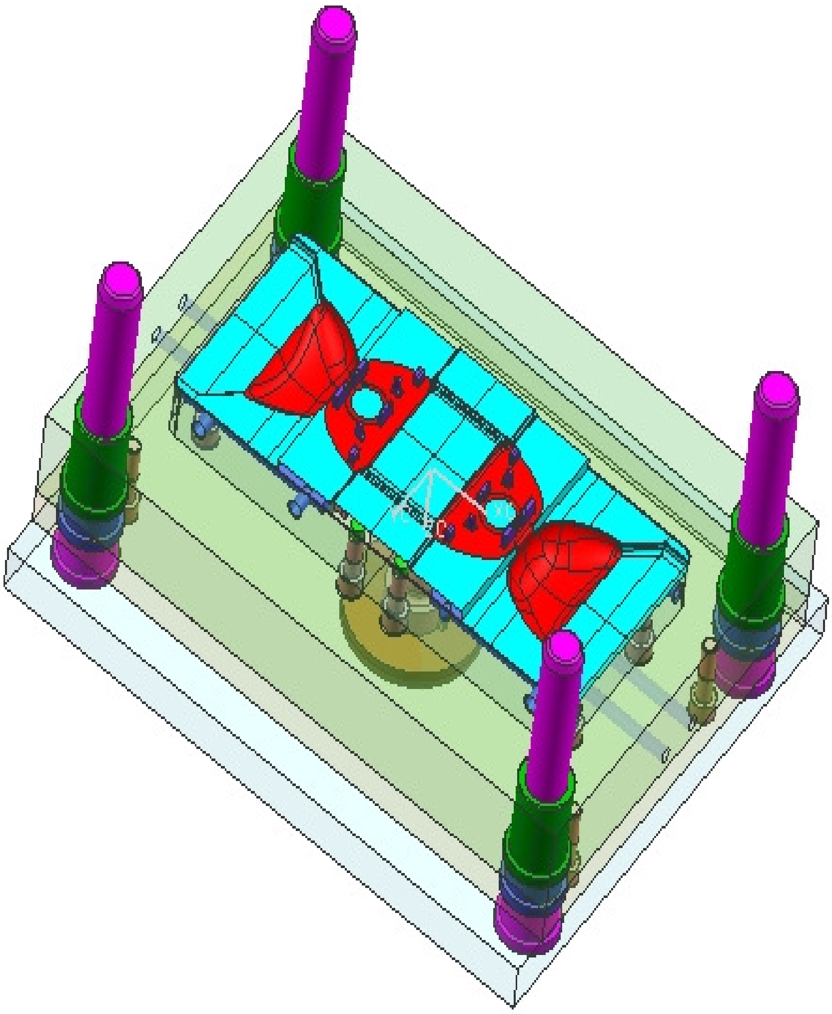
Assembly of the tool may be divided into two groups.

1. Top or fixed half.
2. Bottom or movable half.

FINAL ASSEMBLY

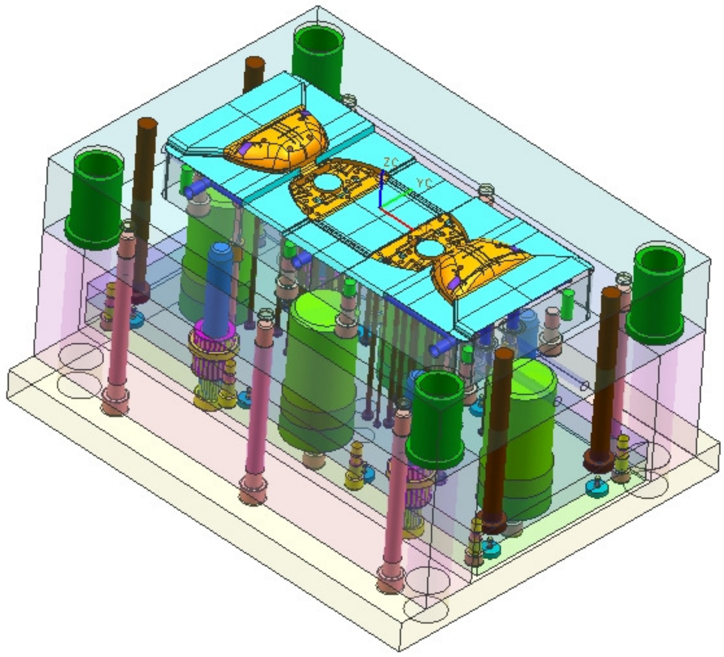


CAVITY HALF ASSEBLY



- All the parts to be assembled are cleaned and lubricated with oil.
- Guide pillar are fixed to cavity housing.
- Runner block is fixed to cavity plate.
- Cavity plate and top plate are clamped together.

CORE HALF ASSEMBLY



CORE HALF ASSEMBLY

- All the parts to be assembled are cleaned and lubricated.
- Guide bushes are fixed to core housing.
- Wear plate and runner block has to be fixed to core plate.
- Core back plate and core plate are clamped together.
- Ejector guide pillar has to be fitted to core back plate.
- Core insert are fixed to core housing by wedges and spaces.
- The mould is tilted and remaining ejector assembly is carried out.
- The ejector guide bush and rest button are fixed to ejector back plate.
- The ejector pins and push back pins are assembled into this respective hole in the ejector plate.
- Then the ejector plate is fitted to the ejector back plate with the help of the screws.
- Spacer is aligned by centering sleeve to the core back plate.
- And bottom plate is fixed to core hous.

Blue matching:

This plays an important role in tooling. This is the final stage of assembly by work.Blue matching is a procedure where a paste known as Prussian blue is applied on any one of the parting surfaces. The two halves are assembled with some pressure for mating of the parting surface.

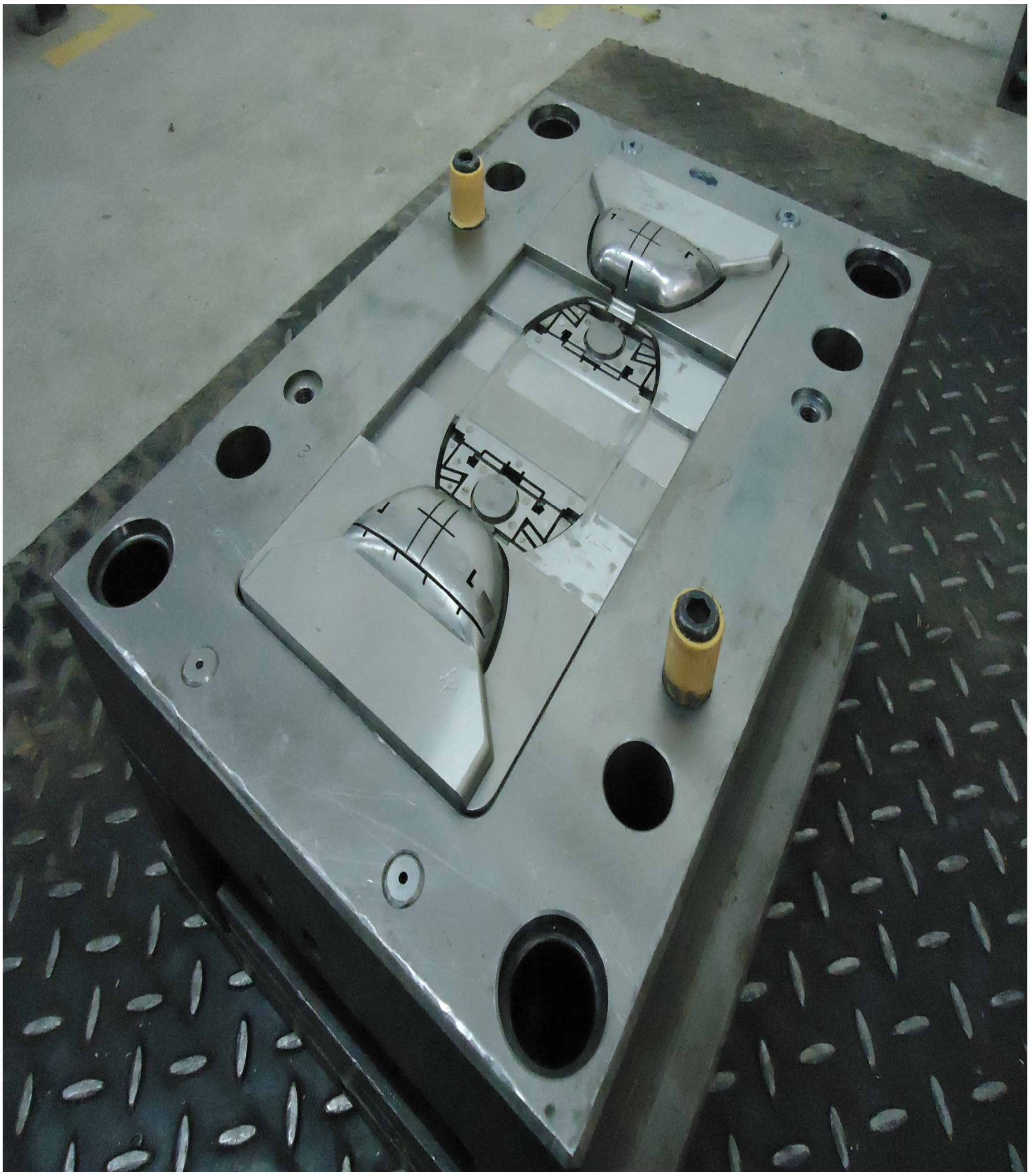
After opening the 2 halves the blue will highlight the high parts on the parting surface. The high points are removed by polishing or by grinding. This process is followed until an even film of blue is transformed from one half to the other.

In this tool blue matching was done to check the matching surfaces.

Steps taken during final assembly:

1. Mating surfaces of all plates and inserts are oil stoned and cleaned to prevent any foreign materials being trapped during assembly.
2. Guide pillars are fitted as per marked referen.

Some of the mould photo



CHECK LIST FOR ASSEMBLY

General: -

1. Fool proofing for assembly.
2. Confirm all the moving parts are guided properly.
3. Care about aesthetic detail.
4. Check the shut height before sending to trial.
5. Check the clamping facilities.
6. Check the mounting features correspond to the machine being used.
7. Check the pillar length in shut height condition.
8. Check for all the necessary information punched on the tool, which is given in drawing.

CHECK LIST FOR MOULD:

1. Check for the alignment of core and cavity.
2. Check and maintain the height of ejector pins and push back pins.
3. Check for angle and nose radius of sprue bush.
4. Check the register ring diameter for suitability for the machine on which it will be trailed.
5. Check for matching surfaces of core and cavity..
6. Check for smooth opening at the daylight.
7. Check for air vent and cooling provided.
8. Check for polishing of profile, runner and gate area.
9. Check for tie bar and eye bolt for lifting.

TYPE OF FIT IN THIS MOULD

Sl No.	DESCRIPTION	TYPE OF FIT	
1	Main guide pillar-main guide bush	Close running fit	H7/g6
2	Main guide pillar-housing	Light key fit	H7/k6
3	Core pin – Core insert	Light key fit	H7/k6
4	Cavity insert- housing	Light key fit	H7/k6
5	Push back pin –core plate	Close running fit	H7/g6
6	Ejector pin – core insert	Close running fit	H7/g6
7	Cavity insert – cavity insert	Light key fit	H7/k6
8	Alignment bush – housing	Slide fit	H7/h6
9	Ejector guide pillar- housing	Medium drive fit	H7/m6
10	Ejector guide pillar- guide bush	Close running fit	H7/g6
11	Ejector guide bush –ejector plate	Medium drive fit	H7/m6
12	Register ring – housing	Running fit	H7/f6
13	Register ring – machine platen	Running fit	H7/f6
16	Wedge block – housing	Light key fit	H7/k6

CASTING

COSTING

COSTING

Costing is the technique or process of ascertaining costs. It is the determination of the actual cost of the product after adding different expenses incurred in various departments. It not only helps us to know the actual cost of the product but also helps to know what they should have coasted. It helps us to know where losses are occurring..

Aims of costing

* Detecting the wastages.
* Helping in reduction of the total cost of manufacturing.
* To help in formulating the policies for changing the prices pf the products.
* To suggest changes in design if the cost is high.
* Determining the cost of each article.
* To provide information to a certain the selling price of the products.
* To determine the cost incurred during each operation to keep control Over worker's wage.

Advantages of costing :

* It keeps control over selling price.
* It is useful in tracing wastage, leakage & spoiled material .
* Profitable & unprofitable activities are traced properly.
* Actual causes of reduction in profit can be easily found.

ELEMENTS OF COSTING

1. Material cost
2. Labour cost
3. Expenses (overheads)

THE ELIMENTS OF COST CAN BE CLASSIUFIED IN TO FOLLOWING:

* METERIAL

a. Direct material.

b. Indirect material.

* LABOUR

a. Direct labor.

b. Indirect labor.

* EXPENSES

a. Direct expenses.

b. Overhead expenses.

c. Factory expenses.

d. Administration expenses.

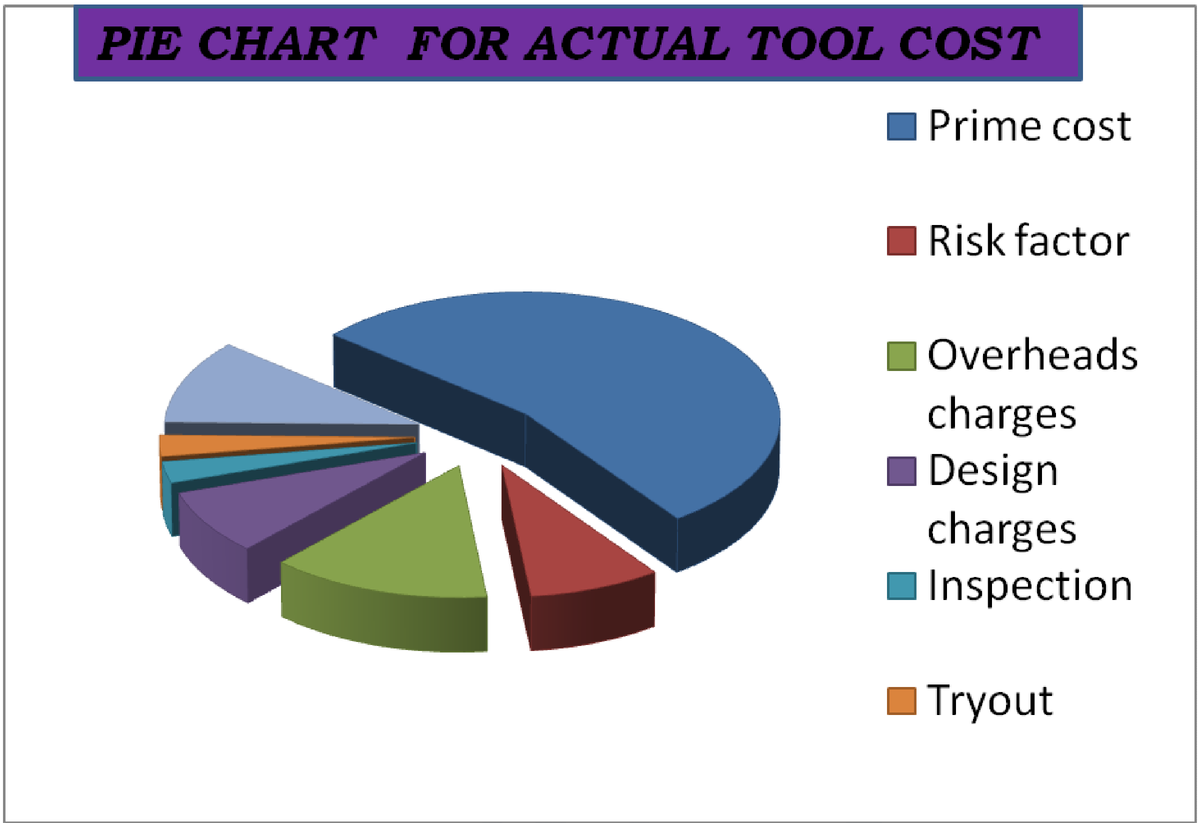
e. Selling & distribution expenses

THE VARIOUS COMPANENTS OF COST OF ANY PRODUCT MANUFACTURED IN ANY PRODUCTION CONSIDERED ARE AS FOLLOWS:

1. Prime cost = Direct material + Direct labor + Direct expenses
2. Factory cost = Prime cost + Factory overheads.
3. Cost of production = Factory cost + Administrative overheads +Miscellaneous overheads.
4. Total cost = cost of production + selling & distribution Overheads.
5. Profit = 15% of Total cost.
6. Selling cost = Total cost + Profit

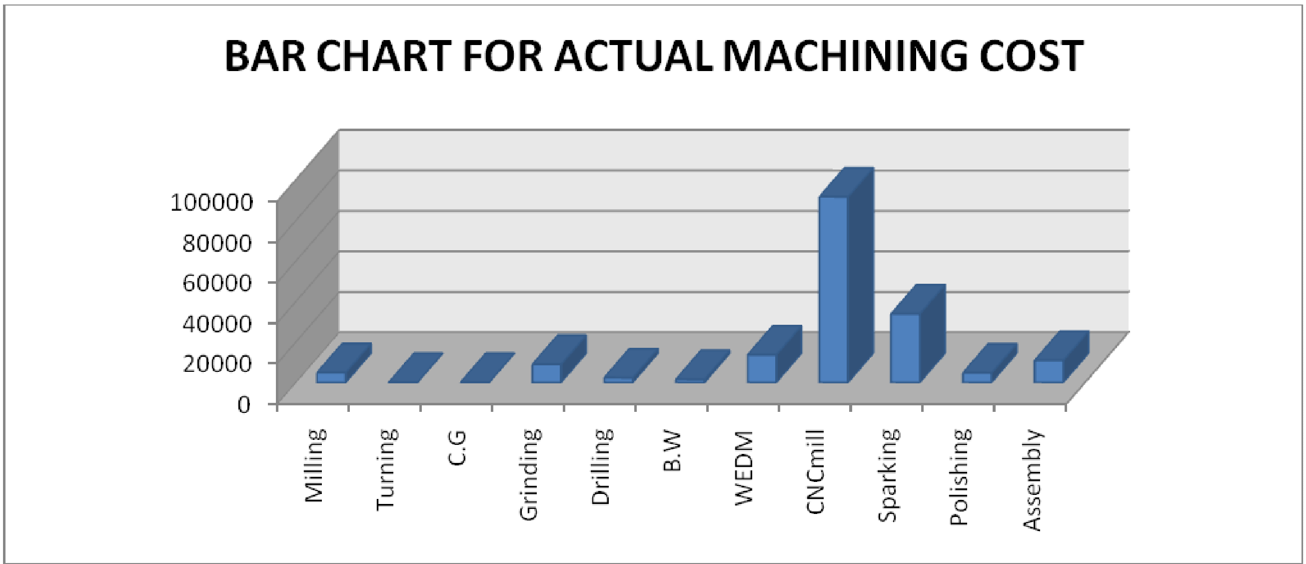
MISCELLANEUOS OVERHEADS

1. Design charges = 10% of prime cost.
2. Inspection charges = 10% of prime cost.
3. Profile margin = 15% 0f prime cost.



SL.NO	ELEMENTS	TOTAL COST (Rs.)
01	Prime cost	5,21,255.00
02	Risk factor(15% of prime cost)	78,188.25
03	Overheads(25%of prime cost)	1,30,313.75
04	Design charges (15% of prime cost)	78,188.25
05	Inspection (5% of prime cost)	26,062.75
06	Tryout(5%of prime cost)	26,062.75
07	Profit (20% of prime cost)	1,04,251.00
	TOTAL TOOL COST	**9,64,321.75**

ACTUAL MACHININING COST AND TIME

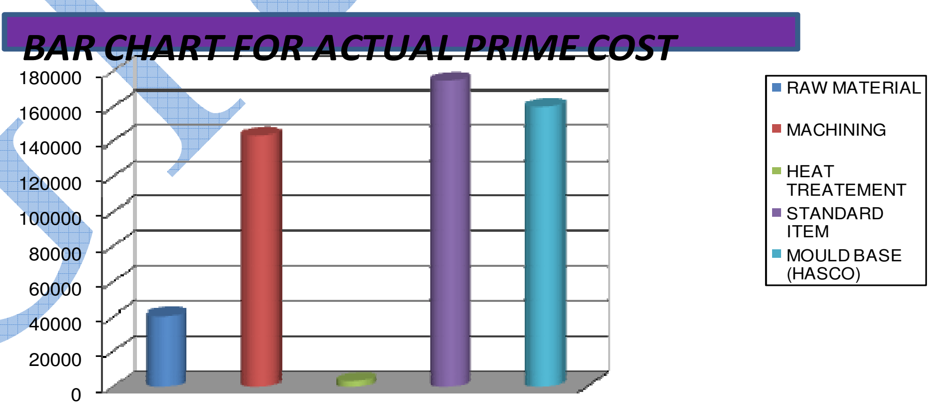


Sl. No	OPERATIONS	RATE /HR IN Rs	M/CTIME IN Hrs	TOTAL COST IN Rs
1	Milling	125	40	5,000
2	Turning	60	3	180
3	Cylindrical grinding	120	1.5	180
4	Grinding	150	60	9,000
5	Drilling	60	40	2,400
6	Bench work	80	20	1,600
7	Wire EDM	250	55	13,750
8	CNC milling	850	108	91,800
9	Sparking	200	170	34,000
10	Polishing	120	40	4,800
11	Assembly	200	55	11,000
	Total machining cost			1,43,110

ACTUAL MATERIAL COST:-

MATERIAL	PRICE/Kg inRS	WEIGHT (K.g)
A2(1.2363)	450	32
1.2767	330	21
ASSAB CALMAX	550	1
VANADIS	250	2.50
ELECTROLYTECOPPER	550	32
P20(1.2312)	210	1

ACTUAL COST AS FOLLOWS:



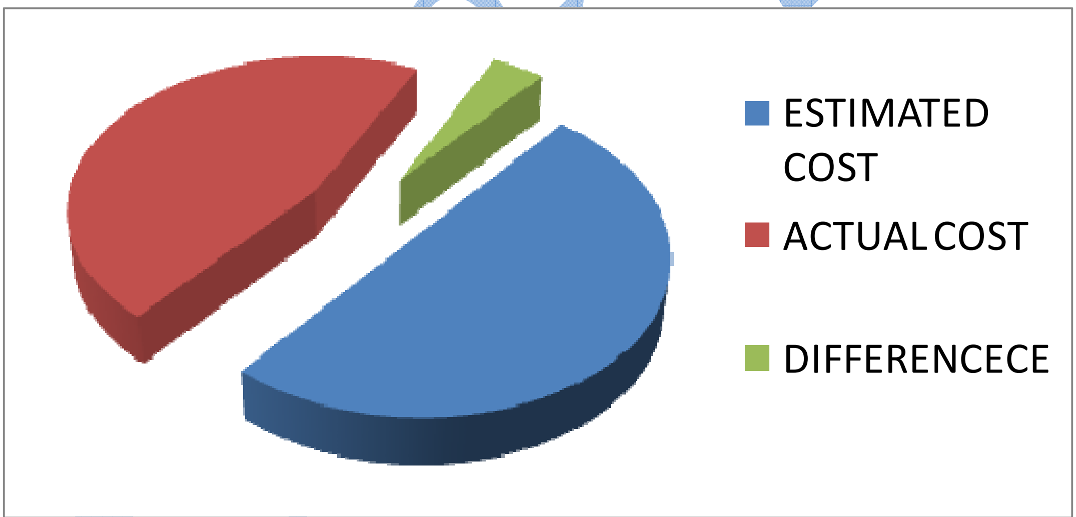
SL.NO	ELEMENTS	TOTAL COST (Rs.)
1	RAW MATERIAL CHARGES	40,315
2	MACHINING CHARGES	1,43,110
3	HEAT TREATEMENT CHARGES	3,345
4	STANDARD ITEM CHARGES	1,74,485
5	MOULD BASE (HASCO)	1,60,000
	TOTAL PRIME COST	5,21,255

DIFFERNCE BETWEE ESTIMATED AND COST AND

ESTIMATED COST – ACTUAL COST

10,46,304.50 - 9,64,321.75

PROFIT = 81,982.75



SL.NO	ELEMENTS	TOTAL COST (Rs.)
01	ESTIMATED COST	10,46,304.50
02	ACTUAL COST	9,64,321.75
03	DIFFERENCECE	81,982.75

TRY OUT

TRY-OUT PROCEDURE:-

The machine platens are thoroughly cleaned and the mould is clamped to the platens by means of clamps and screws. At first the plastics granules are preheated up to 250° Celsius in preheating machine, & then it is poured in to the machine hopper. The material is melted inside the cylinder of the machine and kept ready for injection. Closing and opening of mould halves is checked. The mould is dry run to ensure moulding cycle of core and cavity closing, sliding, hydraulic cylinder actuation and ejector actuation.

The releasing agents are sprayed on the core and cavity and the mould closed with tonnage of 300 tons.

After checking all the things, material is injected. It flows through the machine nozzle to the impression via sprue, runner and gate. The mould is kept to 50° Celsius. The mould is opened after curing time of 30 seconds and component is ejected out of the core and falls in a tray placed at the bottom of the machine. This cycle is repeated to get accurate components and it is called moulding cycle.

TRY OURT;-

After the assembly and before it is sent for production the tool must be trailed out for efficient production and quality of the component .
The mould manufactured and assembled in the workshop should be trailed out on a suitable injection moulding machine and plastic material, which is recommended for trail purpose.

If any problem arises then those defects have to be rectified and reworked so per for customer satisfaction and requirement. The component produced should be of acceptable quality and within specific tolerance limits.
The mould was tried out on injection moulding machine

CUSTOMER REQUIREMENTS:

The mould is designed and builds according to the needs specified by the customer. The component drawings are made and then approved by the customer. Following are the customer needs or requirements as specified by him:

No. of impressions	: 02
Type of mould	: 2-Plate
Preferred gate	: Pin point
Machine	: JSW 550 AD
Type of ejection	: Pin ejection .
Component material	: Poly Propylene (KLD 17%)
Weight of the component	: 197gms.
Component finish	: Gloss.
Mounting type	: Side clamp
NAME OF THE COMPONENT	: "2CV SMALL DUCT "
APPLICATION OF THE COMPONENT	: This component is used in "HONDA BRIO CAR HVAC"

PROCEDURE;-

Firstly the mould assembly is mounted in between the platens of the moulding machine with the help of a crane. Then the two halves of the mould is clamped firmly with perfect alignment. The tool is then preheated with the help of gas so that the temperature of the tool is about.

The two halves of the mould are closed and opened for several times. The movement of the ejector assembly is checked and removing oil and dust cleans the mould.

Movement of platens then closes the mould and clamping force is selected depending on injection pressure and amount of pressure is selected depending on type of material and amount of filling .The injection pressure and the amount of material per shot are set in the machine as per requirement. These machine variables are set by mere calculations or through trail and error method.

The material is then injected into the mould and is allowed to cool hard and set. The mould is opened and the ejector assembly is then actuated to eject the component along with the feed system. This determines the cycle time required.

TOOL MOUNTING FOR TRIAL;-

1.Tool in closed condition with tie bar and eyebolt is lifted by a crane and placed in between the tie bare of the machine.
2.The locating ring is located in the hole provided in the fixed platen so that it aligns in axis with the machine nozzle.
3.Moving platen is moved to butt against the bottom plate with a locking pressure of 80 bars for clamping purpose.
4.The moving and fixed halves are clamped with the help of bolts and bed clamps.
5.The tie bar and eyebolts are removed.
6.Tool is opened manually.
7.Maximum opening of the mould is set.
8.The cooling circuit is checked properly to make sure there is no leakage.
9.Ejection stroke is set to required length by the movement of ejection rod.
10.Purging is done to remove moisture and get a homogeneous melt.
11.The hopper, filled with the material is heated to required temperature and initial trials are taken, to ensure complete melting of material and to clean up the

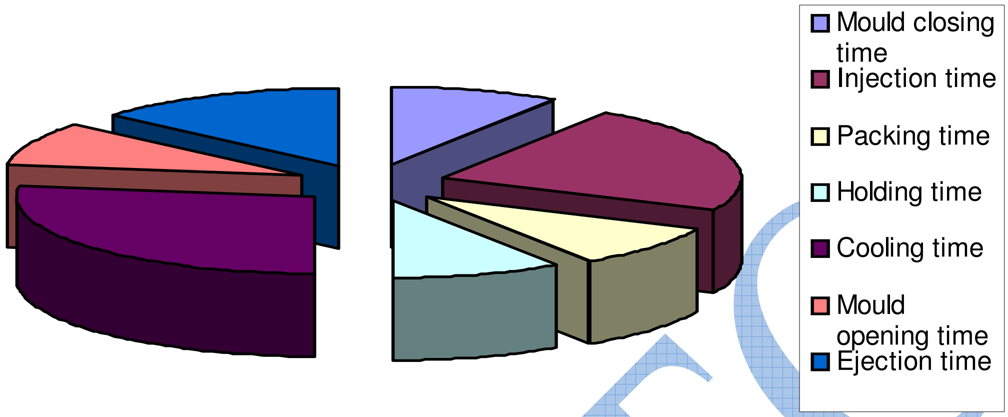
MATERIAL OF THE COMPONENT:

POLY PROPYLENE (KL 17%) is a material especially designed for electrostatic painiting & powder coating applications. The material combines high heat resistance with impact & conductivity in a unique way. It is a thermo plastic.

Following is the chart for the POLY PROPYLENE (KLD 17):-

SL.NO	PROCESSING PARAMETERS	TYPICAL VALUE
01	Injection pressure	18MPA
02	Drying temperature	101^0C
03	Drying time	3 – 4 Hrs
04	Maximum moisture content	0.02%
05	Front – zone 3 temperature	270^0C
06	Nozzle temperature	40^0 -220^0
08	Middle zone 2 temperature	250^0 - 260^0
09	Injection Pressure	18MPA
10	Mold temperature	200^0 - 210^0
11	Hopper temperature	70^0 – 80^0C
12	Rear zone 1 temperature	260^0 – 280^0C

PIE CHART FOR CYCLE TIME



DEFECTS AND REMEDIES

It is the duty of every tool maker to study and analyze the defects of a tool, and since all the requirements of the components cannot be fulfilled on a single trial.

DEFECTS & REMEDIES IN THIS COMPONENT

SL. No.	DEFECTS	REASON	REMEDIES
1.	Short fill.	a) Due to not enough injection pressure. b) The temperature of the mould was less.	a) The injection pressure increased and the mould temperature was rise. b)Temperature controller's temperature was checked.
2.	The weld line was appearing on the component.	a)Injection pressure was the matter.	a) Increase injection pressure.
3.	The burned marks appearing.	a)Air vent blocked. b)Increased melt temperature.	a) Cleane the air vents. b)Decrease melt temperature.
4.	Silver streaks is on the component	a)Temperature of Barrel is decreased . b)Melting temperature is increased.	a) Temperature of barrel should be increased. b)Melting temperature of material is decreased.

GENERAL DEFECTS AND REMEDIES;-

Problems	Possible Reasons	Suggested Solutions
Mould flashes temperature	1) Material is too hot 2) Injection pressure is too high. 3) Die faces warped. 4) Core and cavity not properly matched.	1) Reduce temp. 2) Reduce injection Pressure. 3) Replace both half of die. 4) Match land area and reset mould adjustment.
Incomplete, short molded piece.	1) Material temp too low. 2) Injection pressure is too low. 3) Insufficient feed. 4) Runners and gates are too small.	1) Adjust to required temperature. 2) Increase pressure. 3) Increase feed setting. 4) Enlarge it.
Shrink marks on molded piece.	1) Insufficient material shot Into cavity. 2) Piece ejected too hot. 3) Pressure is too low. 4)" Suck back" when Booster stroke ends.	1) Open runners and gates 2) Increase curing time and immerse ejected component in water. 3) Increase pressure. 4) Consider restricted gating.

Pieces sticks into the cavity	1) Under cuts, burrs, dents or damaged surface on die. 2) Poorly polished surface. 3) Insufficient draft on Cavities. 4) Pieces too soft on Ejection.	1) Remove dents and under cuts. 2) Polish the mould. 3) Give maximum possible draft. 4) Increase cycle time and reduce temperature of die.
Discoloration or burning marks	1) Material too hot. 2) Material traps air. 3) Material hanging in cylinder.	1) Reduce cylinder temperature. 2) Vent the mould and give vent in proper position. 3) Clean the cylinder. 4) Use cold material for reground.
Surface lamination on moulded pieces	1) Material too hot. 2) Too much moisture in Material. 3) Too much mould Lubricant. 4) Contamination with foreign material.	1) Reduce cylinder Temperature 2) Pre-heat the material. 3) Use less lubricant. 4) Use inspected material.

CONCLUSION

This project has experienced me in many technical aspects and I had chance to enrich my knowledge. It also exposed me in adapting procedures and methods of skill. This project helped me to understand and put things to better way of working.

I could experience all the difficulties that I underwent in process of manufacturing and also overcame those difficulties. Working with the group was a great experience and I gained and shared ideas with them.

The mould tool was successfully completed. After the try out process the component was sent for the inspection and the result was quite excellent.

The different dimensions are put to their practical use. The functional aspects of the component were satisfactory. During the tryout process we came across many hurdles but our zeal and enthusiasm solved them all and as a result of this the project was a complete success.

It was only possible by the immense training programme imparted to us during training. I thank to *" PRIMEX PLAST. PVT. LTD, BANGALORE "* and all the staff for their kind co-operation and guidance in course of manufacturing *" YE3J IMV PILLER LOOP CAP"* INJECTION MOULD TOOL and also for imparting tool knowledge to me.

BIBLIOGRAPHY

Important thing in preparing the project report is reference. There are several books and software is used for the manufacturing of this tool.

BOOKS:-

- "INJECTION MOULD DESIGN" - R.G.W.PYE.
- "PRODUCTION TECHNOLOGY" -S.K.HAJRCHOUDARY.
- "MATERIAL SCIENCE & METLURGY" - O.P.KHANNA.
- "ESTIMATION AND COSTING" - BANGA & SHARMA.
- "THERY OF MOULDS" - R.S.NAGESH.

SOFTWARES :-

- PRO-E -WILDFIRE-04 – For tool and component designing.
- ZWCAD -2009 - For manufacturing tool
- DELCAM - For CNC milling.
- E-SPIRIT – For sparking.
- MS OFFICE - For preparing project report.
- HASCO STANDERD – For tool design.

*****